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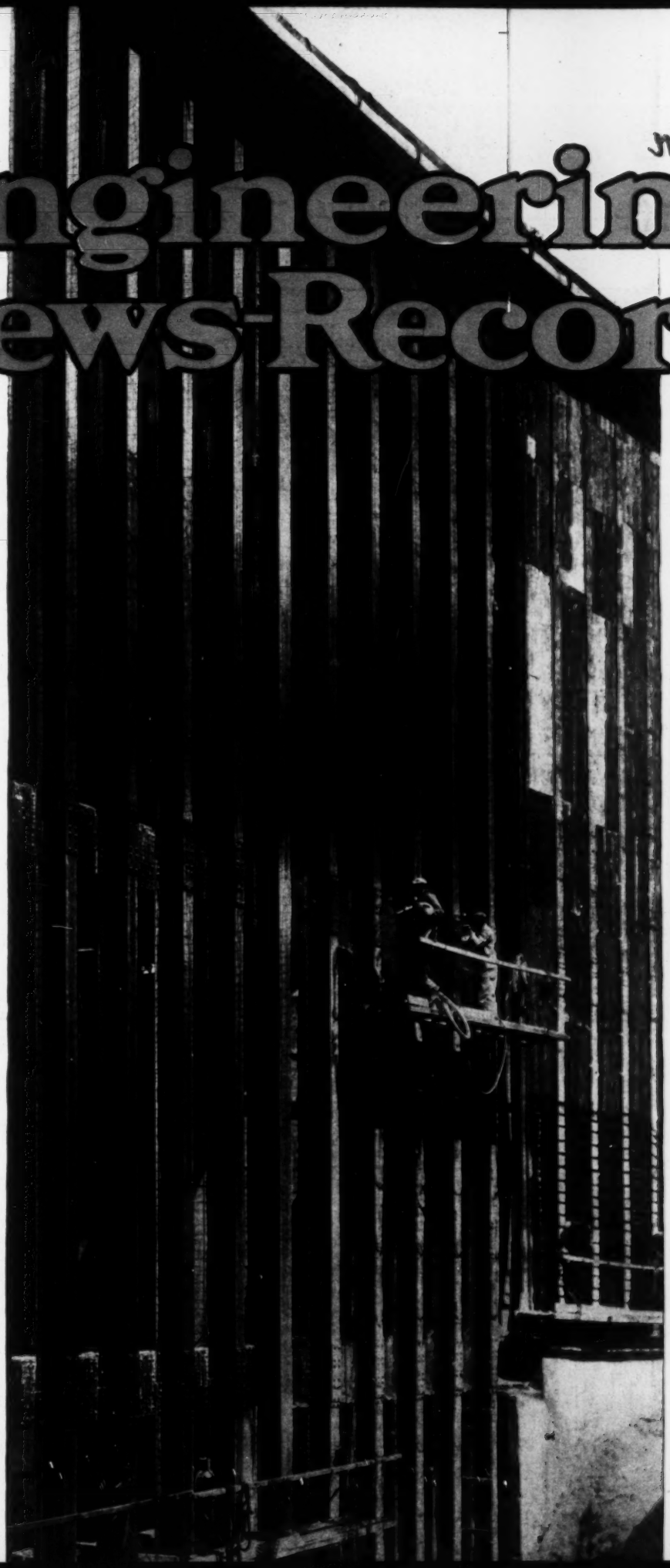

Placing gunite in heavy retaining wall built to provide storage space under high viaduct

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n Appraisal of Draglines for sippi Levee Work

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Diverting the Brazos River to Improve Freeport Harbor

Agricultural Value of Nile Silt Held Fallacious

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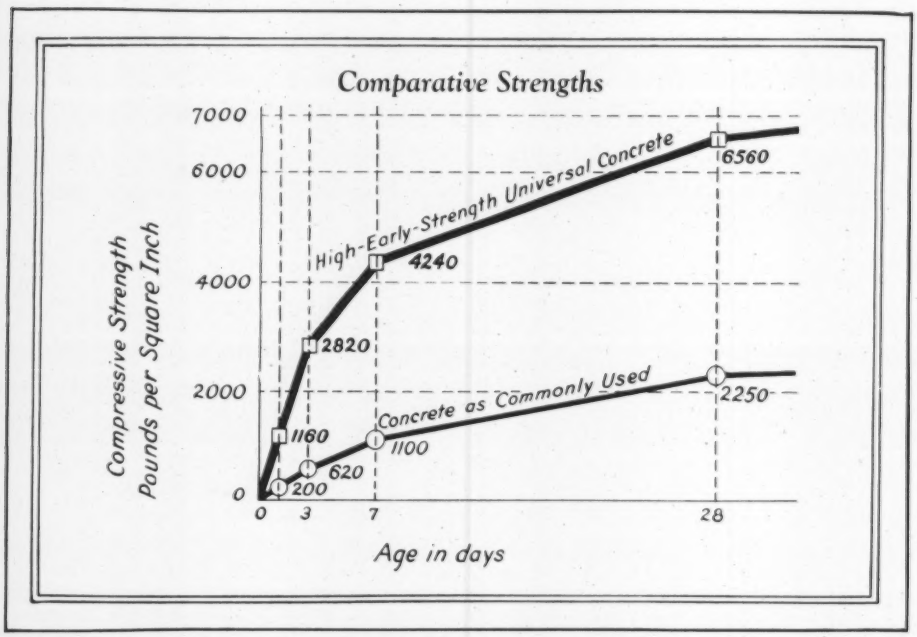

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Volume 102 — NEW YORK, JUNE 20, 1929 — Number 25

Forty-Eight Hours Apart

WITH the inauguration last week of a transcontinental service in which rail and air travel are combined it is necessary once more to alter our conception of the time interval which separates the cities on the Atlantic seaboard from those upon the Pacific slope. When San Francisco was first settled it was weeks away from the cities on the Atlantic Coast, then the construction of the first transcontinental railway 60 years ago cut the time down to a matter of days, and now with the inauguration of the first combined air and rail service the time can be measured conveniently in hours. True, airplanes in the mail service have flown back and forth regularly for many months, but the establishment of air-rail service between Boston and New York on the east and Los Angeles and San Francisco on the west marks the beginning of regular passenger service between the two coasts, cutting down the time to 48 hours for the individual who would go without the inconvenience and cost of arranging special airplane service. There remains, of course, the possibility of a further reduction of time through the use for the entire distance of airplanes equipped with sleeping and dining facilities. How soon such a service may be inaugurated depends largely upon the reception granted this new air-rail service and those soon to be inaugurated.

Florida Changes System

AFTER maintaining for nearly twenty years a single unified system for dealing with Lake Okeechobee and the Everglades, Florida has now decided upon a change of system. By two new laws recently enacted, the state proposes to divide the problem into two parts, respectively flood control and drainage. It establishes two separate district organizations, independent in function and in financing power, though overlapping in territorial jurisdiction. The primary purpose of the division, it appears, is to enable the state to obtain federal aid in regulating Lake Okeechobee for the prevention of floods, under a general plan recently recommended by the War Department, which called for a contribution of about half the cost by local interests. In so doing the state departs from the terms of the original grant, which transferred the Everglades marshlands from federal ownership to state ownership under the stipulation that the state bear the responsibility of draining these lands. Almost equally significant, though in appearance a matter of mere detail, is the second change made in the old system, dealing with the method of governing the drainage district. Heretofore the district has been controlled by a board made up of state officers. But insistent demands for local representation have been voiced in recent years, and accordingly the new law establishes a governing board one-half of whose membership is locally elected. The system so set up represents a new experiment in the planning and execution of large public improvements, especially as it faces a situation of formidable difficulty both because of its past history and because of future requirements. Its success therefore may well be watched with interest the country over.

New Responsibilities Restated

RECOGNITION of the larger responsibilities which the present day places on the skilled men of applied science runs like a thread through recent thought, and has repeatedly found discussion in these columns. Yet it is helpful to quote the emphatic though simple restatement of the fact given last week by Gerard Swope in a commencement address at Stevens Institute of Technology. "Business and industrial organizations," he said, "have become so large that they can no longer be run by one man or a group of men by intuition. . . . Analysis and decision are distinctly the training and attitude of the engineer." And he added, "Industry is seeking new men." These men must be students and analysts, without doubt, but still more must they be gifted with far-seeing breadth of view and unfettered imagination. The engineer possesses some of these, but unless he provides himself also with the others he will not be ready for the larger responsibilities of the future. What the school can do in providing breadth of view and imagination is necessarily limited. The prime duty of developing them rests on the engineer himself, as the central theme of his voluntary post-graduate education. It was fitting that the need should be emphasized before a commencement class; deserves equally the attention of the engineer whose college days are already a memory.

A Case for Study

NOT more than two or three times in the entire history of compressed-air foundation work has a caisson top or an airlock been blown off. For this reason alone the recent bridge pier accident on the Hackensack River is unusually important. It is made still more prominent by the fact that a welded joint caused the failure. The steady spread of welded connections in structural steel work has been accompanied by growing confidence in the dependability of welded joints but the present accident cannot fail to shake this confidence in a measure. This is indicated by the fact that in the present case the contractor has abandoned all welded connections on airlock equipment and returned to the conventional riveted and bolted connections. The nominal stress on the joint was only a few hundred pounds per lineal inch of weld, a very low stress whether for shear or, as in the present case, for tension. But examination of the ruptured joint indicates that the welding had grossly inadequate contact and penetration; and considering the eccentricity of the connection, together with the possibility of a tearing action through unsymmetrical bending of the diaphragm plate, which would concentrate the stress on the weld, the failure becomes less of a mystery. In a great many tests the resistance of a good weld has consistently proved to be high and uniform. A poor weld, however, cannot

be credited with any dependable strength whatever. The case, therefore, presents a challenge to the friends of welding; it is their responsibility to build up assurance that poor welds cannot be produced, or if produced will be detected by inspection. It is only partial defense to say that the few prior caisson blow-ups—at New York, at Cleveland and at London—involved bolted or riveted joints. One welding failure does not condemn the whole art, but the advance of structural welding will be seriously checked unless the present case is made the occasion of thorough study and an insistence on the highest type of design, workmanship and inspection.

Dragline Advance

FEW machines for heavy excavation have developed as rapidly as the dragline excavator. Its latest expression in the enormous mobile draglines for Mississippi levee construction is considered in this issue. Compared with the timber derricks carrying a drag-bucket attachment with which dragline excavator development began twenty-odd years ago the machines now working on the protection dikes of the Mississippi valley are marvels of size and ability. From their inauguration in levee work draglines have established a record for cheap earth moving. Their drawback has been their limited radius of digging and placing in one operation. Even with this handicap, however, their exceedingly low cost of operation enables them to compete even though they must handle the earth twice. Since handling is a waste of labor which makers and users alike regard with impatience the effort toward improvement has gone on continuously. First, greater size and boom reach were resorted to, and later increased mobility. With the methods of support long used—skids and rollers and trucks on rails—increase in size quickly found limits. Any considerably greater advance in working radius had to be sought through easier locomotion. This has been attained through crawler and walking tractions, which also permit easy shifts in direction of travel. Ability to maneuver easily brought new possibilities in the way of operating systems, such as are indicated in the article in this issue. Incidentally the improved locomotion gave opportunity for increase in boom length and working radius. It is entirely reasonable to look forward to working circles of 400 ft. in diameter in the near future. In its new possibilities the dragline excavator continues to command a leading place among the machines available for building the larger-section levees called for in the present flood control plans for the Mississippi Valley.

Crosstown Traffic Relief

A DEFINITE proposal for a crosstown traffic tunnel at New York, connecting with a vehicular tunnel under the East River, has been made by engineers studying the city's traffic problem. Crosstown traffic is a serious problem in every city; it is especially so in New York, with its few wide crosstown streets and many narrow ones largely blocked by commercial vehicles discharging at the curb. Grade separation at all major cross streets has been proposed by many dreamers in the field of traffic control but seldom has that form of relief been found practical because of its cost. Nor would the form proposed for New York be practical except as a completely separated roadway serving as an approach to a river crossing, a roadway upon which a toll can be collected. New York's proposed crosstown tunnel therefore cannot be looked upon so much as a form of traffic relief as a facility for speeding up certain traffic for which it is possible to put a definite value upon lost time. Some traffic relief will, of course, result from the construction of the tunnel proposed, but it will have no noticeable effect upon the general traffic situation in the city streets. The general crosstown problem still remains to be solved; it has been consistently ignored by traffic authorities.

Multipurpose Structures

ADAPTATION of engineering structures to an additional use than that for which they were primarily designed has occurred many times in engineering history. To mention a few: Water-supply reservoirs have been covered and the roofs sodded for public parks and playgrounds; the tops of dams have been utilized as highways; office buildings have incorporated garages and theaters, and recently a huge sports arena was placed in the vast open space above a railway station concourse, this latter being closely analogous to the older practice of making office buildings an integral part of railway passenger terminals. In this issue there is described a viaduct in New York City in which the space underneath the structure has been designed and divided to serve as a city warehouse, shop and sewage screening plant. The location of the structure along a marginal street where under-viaduct space was not needed for an additional street and where inclosure of the structure would not jeopardize light and air facilities for anyone makes it somewhat of a special case. The ingenious space utilization is nevertheless worth the attention of engineers in other cities where analogous conditions are likely to exist. If additional housing facilities for municipal departments are not a necessity, the space could be converted into a parking garage that would be likely to produce considerable revenue.

Eyebars for Cables

STRONG emphasis is placed on the eyebar or chain type of suspension bridge by the design and successful erection of two such structures over the Ohio River at Point Pleasant and St. Marys, W. Va., as described in this issue. As in the Florianopolis bridge in Brazil, opened in 1925, parts of the suspension system are used as top chords of the stiffening trusses. The Brazilian bridge has straight unloaded backstays, and the eyebar chain is a two-purpose member over the center half of the main span only, while the designs of these Ohio River bridges go a step farther and replace the structural top chord with the eyebar chain in the landward halves of the side spans as well as in the main span. Variable-depth stiffening trusses are also an integral part of the designs of these three structures.

Economy and logical design are the principal advantages claimed for this type of suspension structure by its advocates. Briefly, the design is based on the fact that the tensile stress in the cable and the compression in the top chords of the stiffening trusses can be carried by a single tension member, designed for the greater of the two stresses instead of for their sum, the compression member being eliminated. Economy, based on the often-stated principle that truss outlines closely approximating the curve of maximum bending moments provide maximum utilization of material, also dictated the use of the variable-depth stiffening trusses. By discontinuing the use of the eyebar chain as a top chord at approximately

the quarter points of the main span and at the center of the side spans and then sloping the new structural top chord downward toward the towers, maximum truss depths occur at points of maximum bending moment and minimum truss depths at points of maximum shear.

Erection procedure and appearance have been the principal factors upon which opponents of the eyebar-chain bridge have concentrated. Ingenious methods on the part of the constructors of the several bridges so far built have demonstrated that erection of eyebar-chain bridges probably can be handled with as much despatch and economy as erection of the parallel-wire cable type. In considering the matter of appearance the results are not so convincing. None of the above bridges has achieved the pleasing outline and symmetry that characterizes some other eyebar-chain structures, notably the three bridges most recently completed in Pittsburgh.

In large measure, however, the eyebar-chain suspension bridge, as represented by the structure described in this issue, is an important development. With it an actuality, perhaps some of the other innovations in suspension bridge design that have been in danger of molding from lack of use can be given a trial. Substitution of eyebars for cables is only a beginning.

Overproduction

NOT often do events bring a question affecting nearly the whole realm of production into such sudden prominence as was the case during recent days with the subject of overproduction. The federal government intervened in two instances to find a cure for the evil. Those industries that have been complaining of overproduction, or excess of producing capacity over demand, are likely to scrutinize these cases with interest to see whether they contain a promise of something applicable to their own troubles, or on the contrary perhaps a threat of something less tolerable than their present state.

An interstate meeting held in the West, virtually under government auspices, concerned itself with overproduction of oil and possible means for reducing production. At the same time Congress was passing the farm-relief bill, that new law which is to alleviate the harmful results of our agricultural overproduction. The two cases, though similar in the difficulties at issue, are radically unlike in the remedies proposed.

In the one case the several states concerned were invited to find ground for an agreement to limit production—a step which neither the federal government nor the industry itself had authority to take, it would appear, but which the states could take in concert without breach of law. In the other case there was no thought of limiting production even through action of the states, but a remedy is sought in semi-governmental marketing financed by some hundreds of millions from the national treasury as working capital. It is the first adventure of the government in marketing, just as the oil conference is the first federal attempt to restrict production in a purely private field. Both actions are significant innovations. Their strange contrast is stranger still if the mind turns to problems of industrial overproduction.

Just what is over-production constitutes the essential question here. It has had no clear answer, and there is some ground for believing that much of the prevailing thinking about it is rather foggy. The seemingly futile oil-conservation conference centered on the tacit assumption that too much oil is being produced, but threw no light on how it was known that production is excessive, though oil exploration continues. Perhaps current prices are too low. Claims of overproduction are at the heart of the agricultural problem, and in special form they underlie the proposed increase of customs tariff. President and Congress appear to take different positions toward the various overproduction claims, but neither has come forward with an explanation of what constitutes normal and what excessive production. In the field of the manufacturing industries this is a crucial problem.

Is overproduction to be defined by a comparison of total production with consumption? Shall inefficient producing units be counted in the production? Should not every industry have a reserve of producing capacity over normal demand, to enable it to meet demand peaks? And, with a given ratio of excess capacity over demand, when is an industry justified in objecting to the building of new (and presumably efficient) producing units? These questions would appear to be basic. The President has partly answered them in one case, suggesting that some farmers ought to go out of business; but the thought that this same principle might apply to manufacturing industries is apt to awaken uncomfortable reflections. Probably legislators and presidents will never settle this matter of overproduction, but each industry must do so for itself.

In one manufacturing field of interest to the civil engineer, for example, the reasonable producing capacity of all the going plants in the country is a third more than present consumption; and though consumption grows from year to year as the product is applied more extensively, yet newly built capacity keeps ahead of this growth. In another field the margin of capacity is even greater. Sharp competition exists, and there are frequent complaints of unprofitable prices, offered or accepted by the manufacturers either to keep their plants from shutting down or to bring down their costs by virtue of greater output. Is this overproduction, and if so has it sufficient importance to warrant the attention and co-operation of the federal government? Is either state-aided limitation of production or federal-aided co-operative marketing a suitable remedy?

Few industries have attempted to determine where lies the logical balance between the relatively fixed producing capacity and the variable, suddenly changing demands of the market. Some keep current record of consumption, but rarely with full analysis of proper supply radius, and rarely have the figures found use as an indicator of activity ratio or as a criterion of discrimination between normal-profit business and marginal business. Comparisons of production cost and appraisal of manufacturing efficiencies are still more infrequent.

Were such inquiries made within each industry that now believes itself troubled by overproduction, the possible remedies might be discovered more easily. We have no present warrant for believing that the government will take up the duty—we quote from the just-approved farm relief act—of

> "aiding in preventing and controlling surpluses through orderly production and distribution so as to maintain advantageous domestic markets and prevent surpluses from causing undue and excessive fluctuations or depressions in prices"

for the products of manufacturing industry. In so far as there is an overproduction evil in industry, it remains the task of industry itself to search out the facts by co-operative study and find out through its own good sense how "orderly production and distribution" may be approximated.

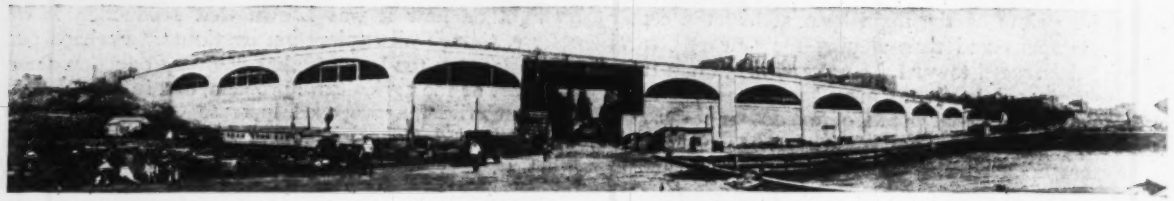


Fig. 1—West Elevation of the New Riverside Drive Viaduct, New York City (The coping line is not broken as shown in this composite photograph)

Building Design Applied to a Boulevard Viaduct

Riverside Drive Structure in New York City an Inclosed Steel Frame Designed for Occupancy of Under-Viaduct Space—Walls of Gunite and of Granite Backed With Gunite

A NEW VIADUCT has recently been opened on Riverside Drive, New York City, which establishes new precedents in viaduct design and construction. It represents the first attempt to utilize under-viaduct space in New York City and is probably the most comprehensive plan of the sort yet carried out in this country. Not only are the sides of the viaduct inclosed in walls but the steel frame is made four tiers high and arranged in practically square panels as contrasted to the usual bent construction joined by long girders. Thus the structure is in effect a three-story steel frame building 90 ft. wide by ¼ mile long with a six-lane boulevard on its roof. In its detailed design, too, several features of unusual interest have been incorporated: An east wall of reinforced gunite varying from 35 to 75 ft. in height carried by closely spaced vertical wall beams; a west wall in which granite hung on steelwork and backed with gunite is supplemented in places with a poured concrete wall utilizing a special aggregate facing which when marked simulates natural granite; a special interior bracing system for the east wall to resist a probable earth fill against its exterior face; heavy girder framing to carry the viaduct roadway over a street underpass; an especially rigid and waterproofed roadway slab; and an unusually heavy balustrade design of steel beams fabricated to the main columns and inclosed in concrete with an outside ornamentation of natural granite.

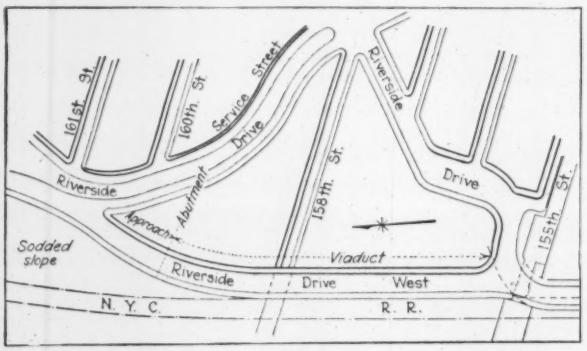


FIG. 2—LOCATION PLAN OF RIVERSIDE DRIVE VIADUCT
Note that it eliminates three curves and a bad intersection at 158th St. on the old route.

The viaduct is located between 155th and 161st Sts. on what is known as Riverside Drive West, since Riverside Drive bypasses the deep ravine which the viaduct crosses. In this location, as shown in Fig. 2, it eliminates three curves and one bad street intersection at 158th St. on the old route. The viaduct approximately parallels the Hudson River and is directly adjacent to the New York Central tracks from 155th to 158th St., where it curves eastward away from the tracks until it joins Riverside Drive again at 161st St.

In addition to being on a curve, the viaduct is on a rising grade, the street elevation at the south end being approximately 60 while at the north end it is 107. No attempt was made to eliminate the curve or the rising grade inasmuch as both were believed to add appreciably to the appearance of the structure.

The proximity of the railroad affected the design of the structure to a certain extent. An underpass carried 158th St. through the structure and across the railroad tracks as shown in Fig. 7. The Transit Commission has authorized a grade-crossing separation at 158th St. which will be at approximately El. 35. Therefore, although the ground floor of the viaduct is now at the same elevation as is 158th St. and the railroad tracks, its main floor is planned to be at El. 35, the present second floor. Trucking entrances are provided at this level and provision made for a ramp, leading from the second to the first floor at El. 15.

FIG. 3—ERECTING THE STEEL FRAME, RIVERSIDE DRIVE VIADUCT
The concrete buttresses brace the east wall against high fills which may later be placed against it. It is planned to use the space between these buttresses for construction material bins.

Future plans for an express highway over the New York Central tracks contemplate that it will be at El. 35 between 155th and 158th Sts. where it will adjoin this new viaduct. Therefore, the west wall construction of the viaduct below El. 35 is of somewhat cheaper materials than are used in the remainder of the structure.

The viaduct is monumental in design, or rather in appearance, for the west elevation, while apparently consisting of a series of stone arches supporting the main roadway, is actually made up of a facing of false granite arches carried by the structural steel frame. The monumental appearance is accentuated by heavy balustrades surmounted by ornamental lamp standards.

Under the viaduct there is some 250,000 sq.ft. of floor space available for the use of the city. Present plans contemplate utilization of this space for a street

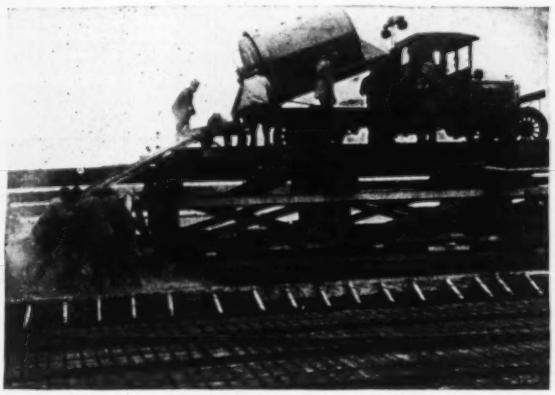


FIG. 4—ROADWAY SLAB POURED FROM ELEVATED PLATFORM WITH READY-MIXED CONCRETE

cleaning department garage, a materials storage yard, a machine shop, and a sewage screening plant similar to those now in operation at Dyckman and Canal Sts.

Two years were required to build the viaduct, the cost of which is approximately $2,360,000, divided $450,000 for the foundation and the remainder for the superstructure. The viaduct required 40,000 lin.ft. of concrete piles, 5,800 tons of structural steel, 30,000 cu.yd. of concrete, 120,000 sq.ft. of granite masonry, and 12,000 sq.ft. of asphalt pavement.

Foundations—At the south end the viaduct crosses filled ground, near its center it encounters an old watercourse, and toward the west end rock is found at depths of less than 14 ft. Reinforced-concrete piles cast in place were used in the filled ground, and in the other sections footings were carried through to rock where practicable. Concrete gravity-section wing and retaining walls inclose a fill which serves as a north abutment, extending about 250 ft. along the center line of the viaduct as shown in the foundation plan. The west wall of this abutment was doweled in order to secure the natural granite facing to the wall.

FIG. 5—VIEW OF COMPLETED VIADUCT LOOKING NORTH
Hudson River suspension bridge tower in the background.

Structural Frame—The viaduct occupies practically the entire width of the 100-ft. street. Its main structural framework comprises four lines of 14-in. H columns 31 ft. 4 in. apart transversely and with a 30-ft. spacing longitudinally in each line (a spacing which will permit a truck to turn at any point without backing), between which beams and girders are framed to provide 17-ft. ceiling heights. Thus at the highest part of the structure near the north end there are three tiers of steelwork above the ground level in addition to the roadway framing. These floors occur at El. 35, 55 and 75. The ground floor level is at El. 15. As the roadway descends toward the south the two upper floors are discontinued, the 75-ft. level extending for only eight panels from the north end and the 55-ft. level stopping at ten panels from the south end; the 35-ft. or main floor level is continuous for the full length of the viaduct.

In general, built-up girders 33 and 54 in. deep span transversely between the columns and rolled girders are framed longitudinally. All transverse girders are punched for floorbeams on approximately 4-ft. centers

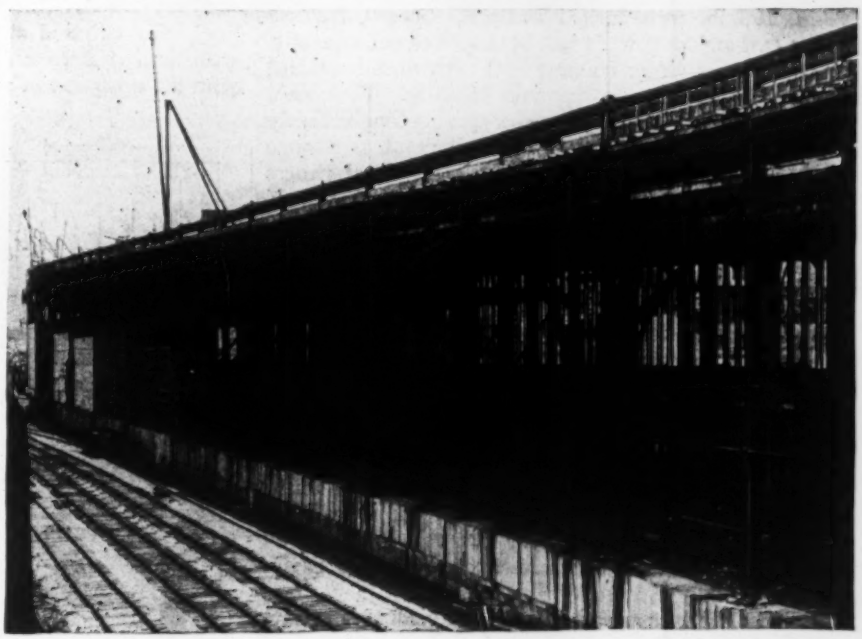
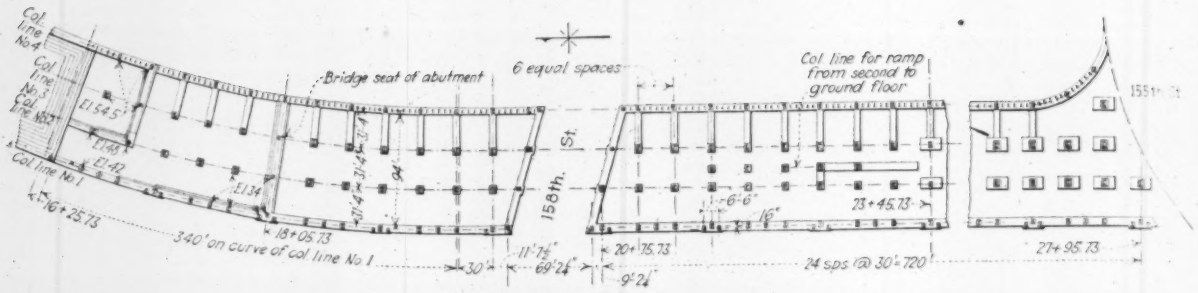
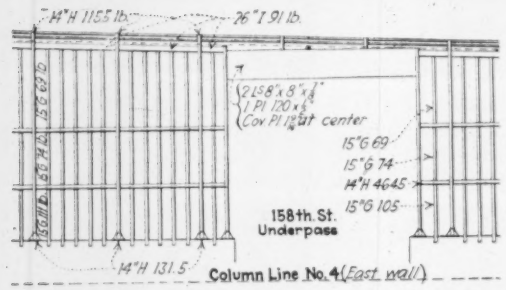
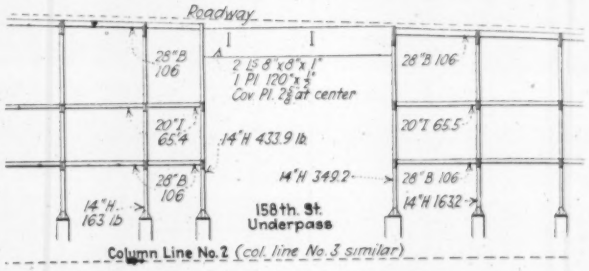


FIG. 6—STEEL FRAME OF WEST WALL
New York Central tracks in foreground. Frame carries granite facing backed with gunite.


Col. line No. 4
Col. line No. 3
Col. line No. 2
Col. line No. 1
Bridge seat of abutment
6 equal spaces
Col. line for ramp from second to ground floor
158th St.
340' on curve of col. line No. 1
24 sps @ 30' = 720'
Foundation Plan





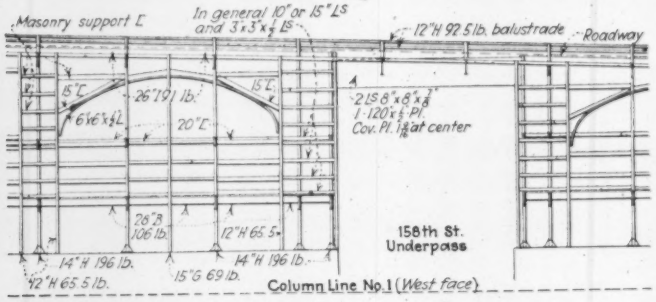


FIG. 7—FOUNDATION PLAN AND TYPICAL COLUMN LINES, RIVERSIDE DRIVE VIADUCT

and these will be added as the types of occupancies of the building necessitate. At El. 55 these girders are punched for 20-in. 64½-lb. I-sections and at El. 35 for 28-in. 106 lb. wide-flanged sections. Special framing in the east and west walls will be described subsequently.

The heaviest girder framing in the structure is utilized to carry the viaduct roadway over 158th St. Four main girders about 10 ft. deep span the opening longitudinally on the main column lines. Three lines of transverse girders 54-in. deep frame into these longitudinal girders in the width of the underpass. Details of the underpass framing are shown in Fig. 11.

East Wall—The east wall comprises one of the unusual features of the structure. Between the main columns, which are 30 ft. apart, 15-in. beams are set vertically on 5-ft. centers, spliced and braced at El. 35, 55 and 75 by horizontal plate girders one flange of which is formed by a built-up channel and the other by a 20-in. I-beam which forms part of the future floor system. Reinforcement consisting of a 4x4-in. mesh of 12-gage wire and ⅜-in. vertical and ½-in. horizontal rods was fastened to these columns and backed with wood forms for the application of a gunite wall varying from 2¾ to 4½ in. thick. It was estimated that this type of wall was cheaper than a reinforced-concrete wall of equivalent strength.

Because the area directly east of the viaduct is private property which may be filled at any time by the owners, some means was necessary for bracing this wall on the inside. Inasmuch as this fill could vary from 35 to 75 ft. in height, the bracing must necessarily be of substantial character. Therefore, at the time the foundations were constructed, heavy mass-concrete buttresses were poured between the footings of column lines 3 and 4, extending in height to El. 35 as shown in Figs. 3 and 7. Inclined steel struts were placed to carry the pressures concentrated at El. 55 into the buttresses, while the pressures from any filling above this level will be resisted by heavy transverse beam connections in the frame. In effect, these buttresses transform the east side of the structure into a counterfort wall.

West Wall—The west wall is also a unique part of the structure and is entirely different from the east wall. Its completed appearance is that of a series of granite-masonry arches with solid panels below the springing line. The elliptical arch openings 22 ft. high are filled with iron frames and wire-glass windows. Actually with the exception of the one at the 158th St. underpass,

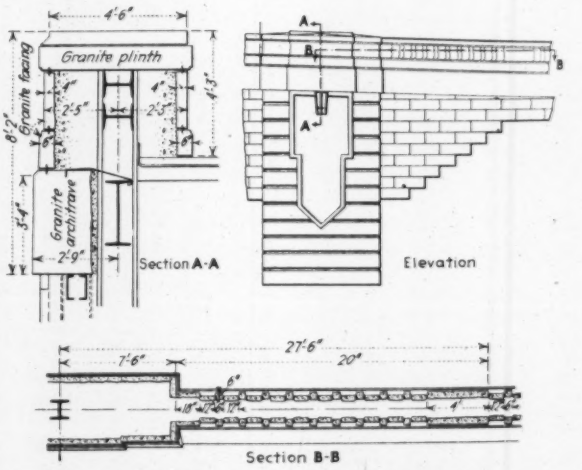


FIG. 8—BALUSTRADE DETAILS (WEST WALL)
The steelwork shown is an integral part of the viaduct frame.

the arches are false, the stonework being carried on structural steel.

The arches have a span of 75 ft. and are separated by pilasters 15 ft. wide. As shown in Figs. 6 and 7, the steel which supports the facing is largely independent of the main columns and girders in column line number 1. The pilasters are built around two 10-in. vertical I-beams, one on each side of each main column and slightly offset toward the face of the wall. Between the pilasters one 10-in. column in addition to the main viaduct columns supports the bent angles and channels carrying the arch stonework over the window openings. Horizontal shelf angles are placed at 6-ft. intervals to pick up the stonework and transfer its weight to the steel frame. The only break in the continuity of the 14 arches which form the west elevation of the structure occurs at the 158th St. underpass, which has a span

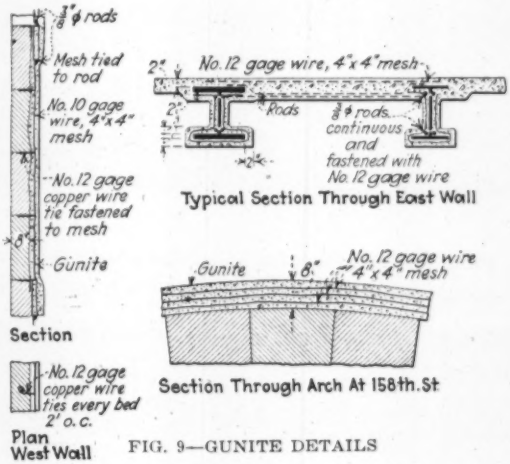

⅜" ϕ rods
Mesh tied to rod
No. 10 gage wire, 4"x4" mesh
No. 12 gage copper wire tie fastened to mesh
Gunite
Section
No. 12 gage copper wire ties every bed 2' o.c.
Plan West Wall
No. 12 gage wire, 4"x4" mesh
Rods
⅜ ϕ rods, continuous and fastened with No. 12 gage wire
Typical Section Through East Wall
Gunite
No. 12 gage wire 4"x4" mesh
Section Through Arch At 158th St

FIG. 9—GUNITE DETAILS

FIG. 10—STIFF-LEG DERRICK SETTING GRANITE FACING ON WEST WALL

Note lamp standard welded to yoke which is riveted to top of column in foreground

built over the New York Central tracks and a cheaper type of wall was devised. This wall was designed to consist of 1:2:4 reinforced concrete with a 4-in. face in which special aggregate was used, consisting of marble dust and granite to which ground slag was added as coloring matter. During construction of this wall it was planned to separate the backing from the face by means of a plate which would be pulled before the wall had set. The contractor found this method to be unsatisfactory and in order to produce a first-class job poured the wall solid with the special aggregates. After removal of the forms the facing was marked with air tools to match the natural granite. The pilasters of 60 ft. as compared with the other spans of 75 ft.

Although the west elevation has the appearance of a natural-granite-faced structure, a portion of the pilasters south of 158th St. is artificial. North of 158th St. all of the facing is natural granite with a minimum of 4 in. to a maximum of 6 in. thick, this granite being backed with gunite with a minimum thickness of 2 in. reinforced with 4x4-in. wire mesh of No. 10 gage wire.

This is believed to be the first time that gunite has been used as a backing for ashlar granite on any large public structure. In placing the walls, a granite course 6 ft. high was erected by the stone masons, the mesh and rods fastened to the granite and the gunite backing shot on.

South of 158th St. the same type of construction was used above El. 35. Below this elevation it is expected that the structure will be masked by the new express highway to be

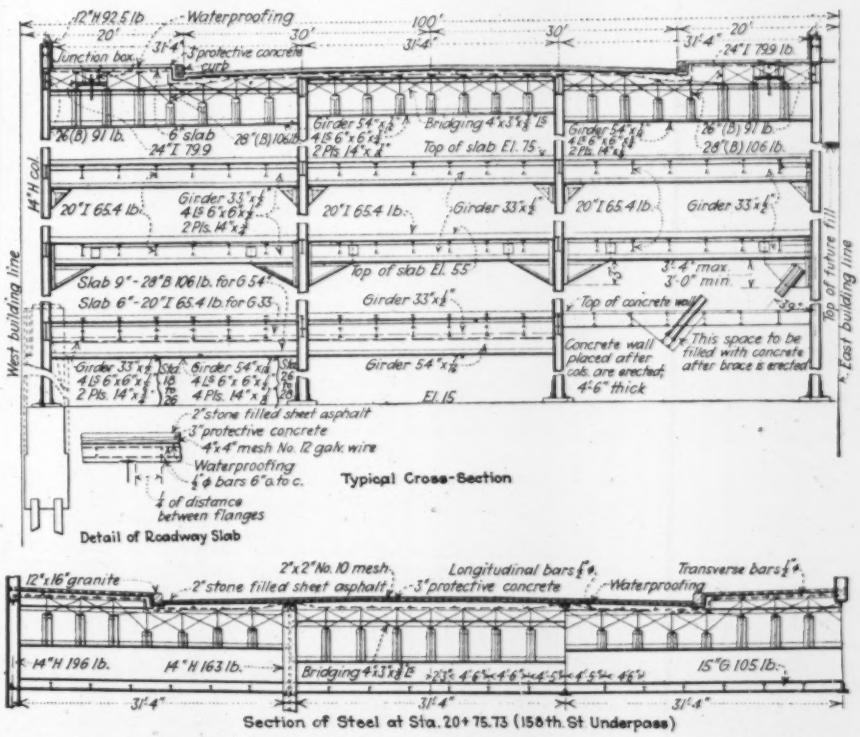


FIG. 11—CROSS-SECTIONS OF STEEL FRAME, SHOWING VARIOUS FLOOR LEVELS

were finished with rough-point work and 3-in. rustications at the joints in the natural granite and were similarly marked on the special aggregate facing.

Roadway—The viaduct has a 60-ft. roadway, ample for six lanes of traffic and is flanked on either side by 17½-ft. sidewalks and heavy parapet walls. The roadway framing consists of transverse plate girders made up of 54x$\frac{7}{16}$-in. webs, 6x6x$\frac{3}{4}$-in. flange angles and 14x$\frac{7}{8}$-in. cover plates, between which the floorbeams (28-in. Bethlehem 105-lb. sections) frame longitudinally on about 4-ft. centers. Bridging of 4x3x$\frac{3}{8}$-in. angles is used between the floorbeams.

Each transverse girder with a span of 31 ft. 4 in. was designed for a live-load of two 12½-ton trucks standing side by side, allowing 100 per cent impact. Two-thirds

FIG. 12—STRUCTURAL STEEL FRAME OF THE RIVERSIDE DRIVE VIADUCT

Panels are approximately 30 ft. square. Note ramp framing in center background. At left are buttresses bracing the east retaining wall.

of the total weight of the trucks was assumed to be concentrated on the rear axle. The sidewalks were designed for a live load of 300 lb. per sq.ft.

A 9-in. concrete slab with about 1 per cent of steel reinforcing was poured directly on the floorbeams. Over the slab a waterproofing of 3-ply cotton membrane fabric and four moppings of asphalt were placed. This waterproofing was covered by a 3-in. concrete slab reinforced with 4x4-in. mesh of 12-gage wire and this topped by a 2-in. wearing course of stone-filled sheet asphalt. It is believed that this type of floor will require a minimum of maintenance, especially since it is placed on such an unyielding support as the structure provides. Expansion joints are placed at 90-ft. intervals and consist of a ¼-in. plate bent into U-shape over which the roadway is carried by sliding cast-steel plates.

Balustrade—The design of the balustrade is shown in Fig. 8. An unusually rigid framework results from extending the main columns above the roadway to form the posts and by framing between them two 12-in. 92½-lb. H-sections laid flat. This steelwork is surrounded by concrete, which, with the natural granite facing, provides a balustrade section with a minimum width of 2 ft. 4 in.

An ornamental lighting system is placed on top of the balustrade. The rigidity of the standards was assured by welding the 4-in. pipe supports to a steel yoke which is bolted to the top of each main column as shown in one of the accompanying illustrations.

Construction of the viaduct was straightforward in nearly every particular. The heavy east wall buttresses were poured with the foundation footings. Guniting followed standard practice. All steelwork was erected by a skid traveler working from north to south on the steel frame. By the use of a 100-ft. boom this traveler was able to set all steel direct from cars on the New York Central siding running parallel to the viaduct.

The deck slab was poured in winter weather with ready-mixed concrete delivered at the job at a temperature not lower than 100 deg. F. In order to make this possible the concrete left the mixer with a temperature of about 115 deg. The haul was about 4 miles and a revolving truck body was used. The trucks were run up a ramp onto an elevated platform, from where concrete was chuted to all parts of the roadway and the sidewalks.

Administration—The complete architectural and structural design of the viaduct was carried out by the engineers of the borough president's office. Julius Miller is borough president, Joseph Johnson commissioner of public works, Clifford Pinckney chief engineer, H. W. Levy deputy chief engineer, J. P. Collyer designing engineer, with A. J. Peck as his assistant; and R. P. Lewis construction engineer, assisted by J. O'Rourke. The foundations were placed by the Reino Realty Corporation, Inc., while the general contractor on the superstructure work was the P. T. Cox Contracting Company, of New York City, P. T. Cox president and W. P. Fitzpatrick chief engineer.

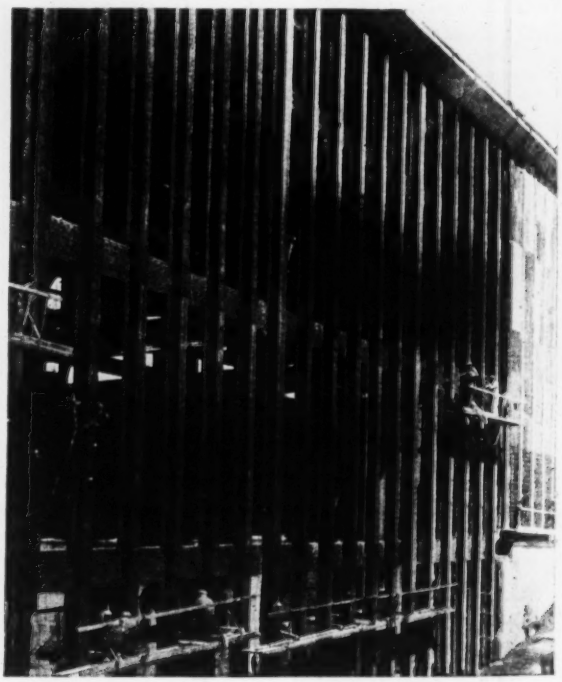


FIG. 13—GUNITING THE EAST RETAINING WALL

Vertical beams placed on 5-ft. centers. Wire mesh and steel rod reinforcing used. Maximum thickness of gunite 4½ in.

Loaded Holes Exploded by Bolt of Lightning

During the construction of the Bull Run dam for the city of Portland, Ore., lightning struck near the battery end of a long lead wire, traveled 200 ft. along the wire and set off seven of fourteen loaded holes where twenty men were working. One man was blown into the air and several were struck by flying rock, but no one was seriously hurt.

An Appraisal of Draglines for Mississippi Levee Work

Traction Device Vital Factor in Practical Development of Larger Machines Required by New Levee Sections—Diesel-Powered, 150-Ft. Boom, 6-Yd. Draglines Now Available

By J. C. French
Sales Manager, Monighan Manufacturing Corporation, Chicago, Ill.

THE WRITER of this article speaks with the authority of a trained mechanical engineer of long experience in the design, manufacture and operation of heavy excavating and earth-moving machinery. In particular he speaks as a user, having been field superintendent of installation and operation as well as designing engineer. For two years, 1915-1917, he was chief engineer for the Parsons Company, of Newton, Iowa. From 1917 to 1923 he was chief engineer for the Austin Machinery Corporation and from 1923 to 1928 he was sales engineer for the Marion Steam Shovel Company, of Marion, Ohio. In his present position he is devoting his entire time to the Mississippi flood-control work, making a general study of operating conditions and locations from the standpoint of equipment application. —EDITOR.

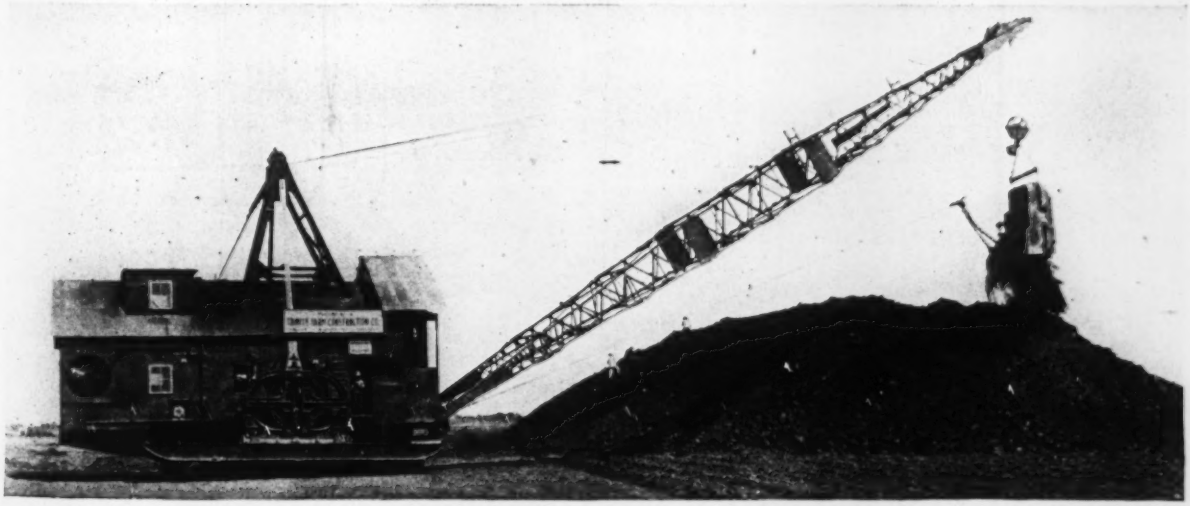
THE excellent record of the dragline excavator on the older Mississippi levees and with the original conditions of borrow commands its earnest consideration for the new larger levees and less easily available borrow. In such a consideration tradition must be put aside. There have to be appraised the possibilities of larger machines; the increased flexibility of movement and greater stability of footing insured by modern traction devices; the warrant afforded by larger volumes for greater plant investment; the economic limitations of rehandling and the possibilities in devising operating systems and working sequences which will eliminate lost motion.

These are intricate problems. On the Mississippi levee work they are complicated by weather and ground conditions, overflow, broad berm and shallow borrowpit requirements and the rigid time limits enforced by high water. Indeed the uncertainty of the operating conditions make them a major problem in the river levee work. They too are present on every operation either singly or in some combination and they are definite factors in selecting construction equipment.

Factors Controlling Equipment

On the Mississippi the working season is short. The government requirements include a definite time limit for construction and a penalty clause is inserted in the contracts to insure the completion of the work on time. This time limit is a construction requisite. Completed levee must be guaranteed to meet the high waters of the spring flood. So essential is this guarantee that in cases where the construction is dangerously late it becomes compulsory for the government forces to move in onto the work and finish it. Under these conditions the equipment used must be of large-yardage types. Again, the new levees are larger. The yardages exceed those specified in the past in some cases by 100 per cent. Outstanding, then, is the requirement that equipment must have large-yardage capacity.

Constant-yardage capacity is a second and equally important requirement. To meet it equipment must be largely independent of weather, ground and water conditions. To be so it has to work from a position above any interference by moderate batture overflow or borrowpit flooding, it has to be able to excavate under water and it has to be capable of shifting position on soft ground without bogging down. With any of the Mississippi delta soils much rain or high groundwater makes the ground exceedingly soft. Any system of earth moving which calls for moving loads over this soft ground is virtually unworkable until the ground dries out. Only machines with large-area traction devices have any chance of changing position readily and safely.



MODERN LONG-BOOM DRAGLINE BUILDING MISSISSIPPI LEVEE

In general Mississippi levee construction at its best is not an easy task. The conditions that surround it are all of a different and more difficult class than those found on the average earth-moving operation elsewhere. A contractor must be familiar with all these special conditions and be prepared to meet them by putting equipment on the work that is capable of successfully combating their detrimental effects and still be able to produce the yardage and the character of construction required by the government specifications.

Dragline Excavators

A review of the equipment now in use for dry fill construction of levees on the Mississippi indicates the long-boom dragline excavator to be the outstanding all-weather machine. It has a reputable history, having been used for years in the lower river districts and more rarely in the upper river districts, where the hauls are long because of borrowpit conditions and the wide berms. Even in the latter situation, however, it has wider usefulness than has been recognized in practice. With long boom carrying large buckets it can excavate from borrowpits and put the material into levee with only 25 to 50 per cent rehandling. The reason that wider use has not been attained is that in the past the small yardages did not justify the considerable investment cost. This situation, with the new flood-control program, is obviously improved. Increased yardages and dimensions of levee, however, make necessary larger machines with longer booms.

Larger Dragline Possibilities

The possibility of larger dragline machines is tied up closely with the problem of load distribution on soft ground and this is a function of the traction device used to propel and maneuver the machine. Briefly, it is found that if a machine has a distributed weight of less than 7 lb. per sq.in. it can be operated on the delta soils regardless of total weight or boom length. The weight, however, must be distributed.

The prevailing earlier machines were truck mounted at the four corners of the underframe, the four trucks traveling on two standard-gage railway tracks which, with additional blocking, distributed the corner loads. A frequent trouble with this mounting was that one corner would sink and throw distorting strains on the frame and mechanism. As a result of this difficulty the government engineers, who have been the chief users of these machines, do not recommend a truck type of machine to weigh over 325 tons. This limits the possible boom length to 150 ft. In fact this is the boom length with 5-cu.yd. bucket that the government engineers recommend.

The 150-ft. boom truck-mounted dragline is not capable of handling the materials efficiently to construct the larger levee sections of the new flood-control work. The volume of rehandled material will not be less than 47 per cent, caused by the boom reach limitations requiring five settings. A 175-ft. boom on a truck-type dragline will reduce the settings to three and lower the rehandle percentage to 30, but a machine of this type capable of carrying this boom length will exceed the weight limitations of the ground. In order to use such a machine efficiently and economically the work projects would have to be selected and its use would be of no benefit to a contractor.

With modern distributed-weight traction devices, a machine so mounted can be provided with a 150-ft. boom having a reach of 160 ft. and efficiently operate so as not to overload the delta soils or hamper movement. The extra boom length necessary to reduce the rehandling of the materials is obtained by the quick maneuvering ability of the flexible traction device at right angles to the levee sections.

Dragline Operating Methods

The desired and most efficient method of levee building is by stations. This allows complete estimates, which are favored by the government engineers. The completion of each station before going ahead also cuts down erosion and wash replacements and constantly narrows down the contractors' responsibility for guarding structure. Equipment and a method of operation are desired which will build full-section levee without repeated retracing of steps. Again, borrowpit conditions do not always guarantee the correct yardage within the same distance from levee and berm. Hollows, cuts and depressions in the ground of the borrow area make it necessary to step back at these points to find the necessary material for the levee.

Complete-section construction with minimum rehandling of material requires the machine movement at right angles as well as parallel to the levee. Unless these two movements are possible rehandling quickly exceeds the economic volume. Preferably the possibility of two-way movement should be inherent in the traction device; the traction should be capable of diverting the line of travel sharply right or left from the course parallel to

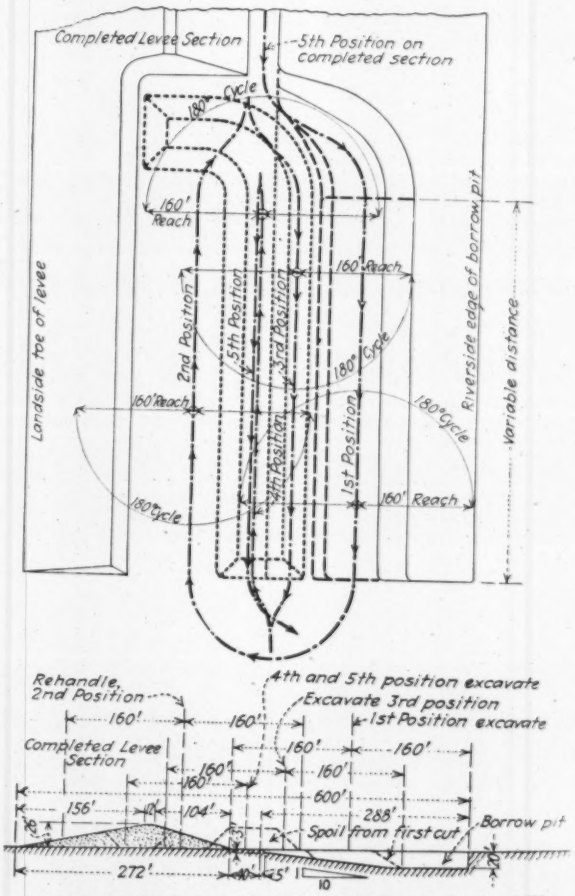


FIG. 1—MACHINE ROUTING CHART IN PARALLEL ONE-LINE SYSTEM OF DRAGLINE OPERATION

the levee. Lacking this ability in the traction device, more trips and more rehandling will be necessary. In brief, the amount of rehandling materials and of retracing travel along the levee is interlocked definitely with the traction device used.

Based virtually on the method of traction there are two systems of long-boom dragline operation: (1) the parallel or one-line system and (2) the right-angle-parallel system.

Parallel-One-Line System—The parallel or one-line system is used when the machines are mounted on either trucks, skids or rollers. In fact these mountings practically necessitate one-line operation because of the difficulty with them of moving so heavy a machine in any direction except straightaway. In general on the Mississippi only the truck-mounted machine has to be considered; the skid and roller mountings are becoming obsolete.

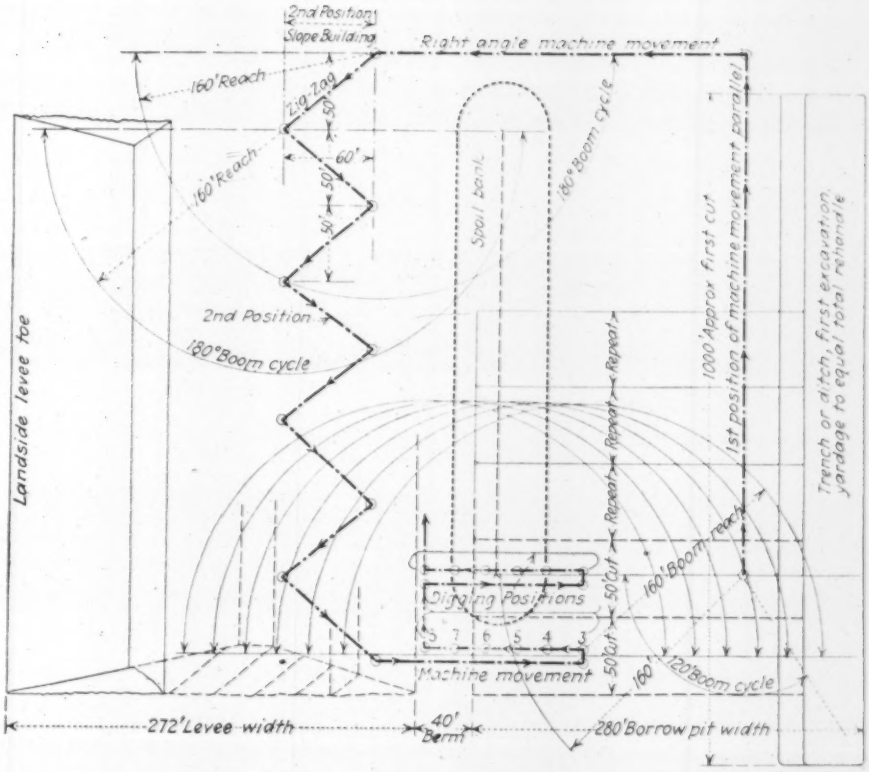


FIG. 2—MACHINE ROUTING CHART IN RIGHT-ANGLE PARALLEL SYSTEM OF DRAGLINE OPERATION

The plan of operation is shown by Fig. 1. Coming down from its last trip (fifth) on the completed levee section, the dragline is swung out over the borrow area far enough so that the boom reach just covers the estimated riverside edge of the borrowpit (first position). Excavation is then started, digging from the deepest part of the borrowpit and with a 180 deg. swing depositing in a spoil bank for later rehandling. The machine moves ahead excavating and depositing spoil for as long a stretch as the contractor may determine—in some cases a stretch of ten stations, or 1,000 ft., is opened up. After the determined length of spoil bank is placed the machine is maneuvered around the end to a route parallel to and between the spoil bank and the landside toe of the levee (second position). The operation then consists of rehandling the spoil bank into the landside toe of the levee within reach of the boom. When this is finished the machine is again swung parallel with the borrowpit (third position) and excavation from borrow is placed in the riverside toe of the levee. The idea is to build both toes of the levee first so as to form dikes which will check sliding of the higher center fill when it is placed by the fourth trip of the machine (fourth position). The final trip of the machine accomplishes any cleaning up and topping that may remain to be done and also brings the machine back to continue with another stretch of levee.

These five trips are the minimum number possible with the system being considered with machines having 150-ft. booms and 160-ft. reach. Under adverse borrowpit conditions the number of trips may be greater and consequently the volume to be rehandled larger. The only other resort of local deepening of the pits has to be counted out of consideration as long as the government engineers continue their present zealous guard of borrowpit dimensions.

Right-Angle-Parallel System—The right-angle system is employed only when the machine is mounted on a flexible, distributed-weight, traction device, and consists of moving the machine at right angles to the levee section back and forth in a zigzag path, finishing each station as the machine progresses forward or lengthwise of the levee. The routing of the machine is shown by Fig. 2.

In general the plan consists of placing the machine within boom reach of the extreme riverside edge of the borrow (first position) and excavating a trench or ditch having a section equal to the estimated volume of rehandling necessary under the existing conditions and borrowpit dimensions. This trench or ditch is dug for a distance of approximately 1,000 ft. with the machine moving parallel to the levee and transferring the material as close to the levee section as possible within the maximum reach of the boom. After this lengthwise distance has been reached the machine is then moved to a position between the spoil bank and the proposed levee section (second position) and the operation then consists of rehandling the spoil bank into the landside toe of the levee. The material is spread so as to build the section to full dimensions by zigzagging the machine as it advances forward. After this spoil bank has been transferred into the levee section the machine is then placed in position for right-angle operation and a pit is opened about 50 to 75 ft. in width at right angles to the levee section. It is started at the trench or ditch mentioned above and continued toward the levee until the borrowpit is completed. The earth thus excavated is placed first in the riverside toe of the levee and then by sections into the body as the machine and boom reach advance toward the levee (Fig. 3).

This system finishes the levee complete by stations. It requires a flexible traction unit to accomplish all the

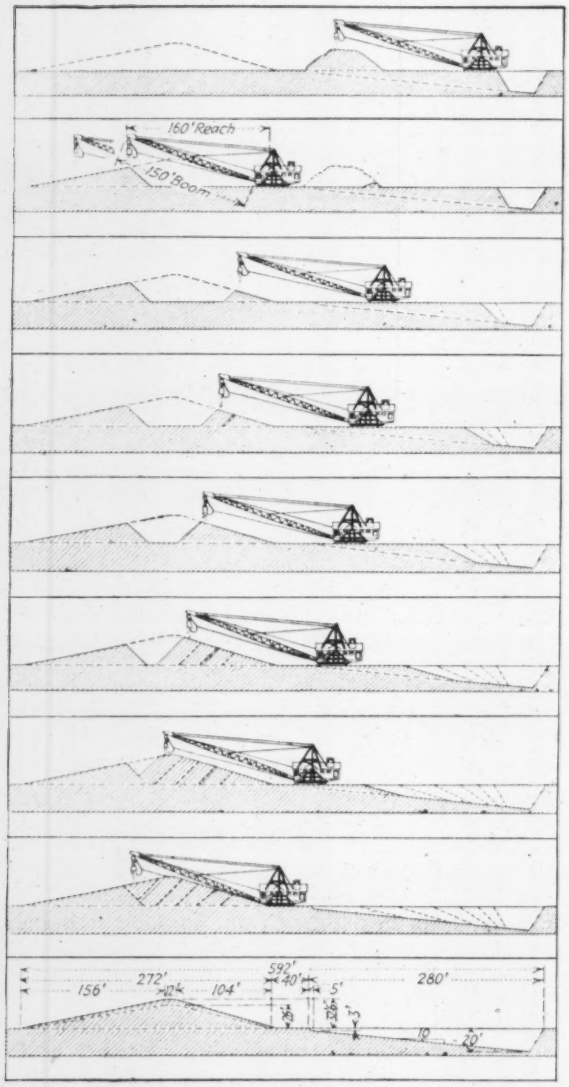


FIG. 3—OPERATING SEQUENCE IN FULL-SECTION LEVEE CONSTRUCTION BY DRAGLINE

movements; sidestepping and zigzagging must be within the ability of the traveling device to permit excavating and transfering the material as described. Construction is faster because the machine is not delayed by track or timbering placement, which usually delays machines of the truck type about two hours a day to move ahead to the next day's operating position.

General Advantages of Draglines

Long-boom dragline machines can move levee material at a much lower cost and with less man power and lower maintenance than any other type of equipment. They can even rehandle the material twice and still transfer the earth from the borrowpits to the levee sections at a lower cost than by any other known method. The single-unit method is in principle also a better proposition for a contractor than any system that includes the installation of a number of small earth-moving units that have to co-ordinate perfectly in order to obtain equal outputs at a much higher cost.

A comparison of the long-boom dragline and any other system, however, must be made between the diesel-driven, long-boom types rather than the steam-driven types. Diesel-engine power plants for draglines are no experiment; they have been used in the drainage and irrigation fields for the past ten years with unusual success. They have been used on machines located in isolated places in the southwestern part of the country where any engine trouble would have delayed the operation for weeks, and the results have always been unusually satisfactory.

Many of the present levee contractors still cling to the steam-driven machines with the natural result of higher costs and delays. Boiler troubles, waiting for coal, water and steam, taking water and coal and extra man power are all sources of delay and expense and it is estimated that 10 per cent of the operating time is lost due to the delays that are inherent with the steam power plant for levee work.

Premixed Oil and Aggregate for Highway Surfacing

Central Plant Mixes Crushed Rock With Hot-Oil —Method Tried in California for First Time as an Experiment

THE SUCCESS attained with road-mixed oil and rock surfacing has led the California Highway Commission to experiment with premixed oil and aggregate on 10 miles of new highway near Oxnard, Calif. This highway had been graded two or three years previously, the end-dump method for making fills being used, and an oil-mixed surface was considered most easy to maintain and to restore should settlement take place. Its low cost and the possibility of later reshaping it to provide a subgrade for concrete paving, which is expected to follow in a few years, were also items in its favor.

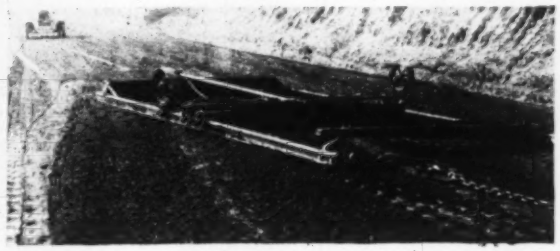
The rock for the surfacing was quarried about 15 miles from the point of use and was hauled by gasoline locomotive a few hundred feet to the crushing and mixing plant on the highway. Here it was dumped through a jaw crusher and delivered by belt conveyor to a cone crusher to give 1-in. maximum size, from which it was taken by a bucket elevator to a revolving screen on the top of the bunkers, one of which contained rock of 1 to ¼ in. size; the other, sand, including screenings and dust passing the ¼-in. screen.

Proportioning the aggregate to conform to the state's specifications required that 50 to 70 per cent of the material passing the 1-in. screen be retained on a No. 3

SPREADING PREMIXED OIL-TREATED SURFACING
Truckloads of 6½ tons spread 8 ft. wide and about 34 ft. long.

sieve. Of the material passing not less than 8 or more than 20 per cent must pass a 200-mesh sieve. This necessitated the addition of fine wind-blown beach sand. The proportions selected for batching were 40 per cent rock and 60 per cent sand. The grading for a typical batch is given in the accompanying table. Altogether the plant produced 41,190 tons of oil-mixed surfacing and an additional 8,110 tons of aggregate without oil, which was used as a base on short sections where the soil conditions required it.

The oil was delivered to the plant by tank trucks and pumped into a 14,000-gal. tank on the hill, whence it



DRAGGING TO COMPACT THE SURFACE
The drag, by raising it on the wheels, is reversed without disturbing the surface.

flowed to the mixer by gravity. A 35-hp. steam boiler operated the oil pump and furnished steam for heating the coils in the tanks, maintaining the oil at about 195 deg.

The aggregates for the batch, consisting of 738 lb. of rock and 1,108 lb. of sand, were weighed and dumped into the mill, followed by 64 to 66 lb. of oil. The mixing time was 30 seconds, and it required 15 seconds to load and discharge the batch. The amount of oil required in the mix was determined by means of an empirical formula developed by the California Division of Highways as a guide to preliminary proportioning. The formula is $P = 0.015a + 0.03b + 0.17c$, in which P is the percentage of oil required, a is the percentage of aggregate retained on a 10-mesh sieve, b is the percentage passing 10 mesh and retained on 200 mesh and c is the percentage of material passing the 200-mesh sieve. According to this formula the amount of oil to be used was 3.57 per cent. However, it was found necessary because of the poor grade of rock and its

SCREEN ANALYSIS OF AGGREGATES

Screen	Per Cent Passing—Rock	Sand	Mixture
Passing 1½ in.	100	....	100
Passing ¾ in.	22	....	68.8
No. 3	6	97	60.6
10 mesh	1.5	72	43.8
20 mesh	....	58	34.8
40 mesh	....	46	27.6
80 mesh	....	30	18.0
200 mesh	....	10.5	7.3

tendency to grind up under traffic to add from 8 to 10 per cent more oil than was required by the formula.

The mixed material was hauled to the road by a subcontractor using seventeen trucks carrying 6½ tons per trip. The contract price for hauling was 50c. a ton for an average haul of 6½ miles and 60c. a ton for an average haul of 12½ miles.

At the point of use, the mixture was spread from the truck, each load covering a strip 8 ft. wide and about 34 ft. long. Three strips covered the highway, which was 24 ft. wide. The material was then leveled with a light tractor equipped with grader attachment which was found capable of handling considerably more than the plant output of 535 tons per day. A 30-hp. tractor and drag were used to compact the surface, by continual dragging for half a day after spreading. The drag was made of old iron rails and was equipped with grader blades, as shown in the accompanying view. Besides this motor equipment two laborers were required to dress up the edges and fill in the low places.

The depth of surfacing required depended on the character of the subgrade. About 74 per cent of the job was 4½ in. thick and 5 per cent consisted of a 3-in. dry-aggregate base course with a 3-in. topping of the oil mixture.

A seal coat was used on approximately 6 miles to afford a surface more impervious to the winter rain and also to prevent raveling. The cost of this seal coat, 32,200 ft. long and 24 ft. wide, consisting of fuel oil and coarse sand, was $3,411, including labor and material. A medium-grade fuel oil was used on one part of the work and a heavy-grade fuel oil was tried on another. The amount of oil used varied from ¼ to less than ⅛ gal. per square yard. It was found that the best results were obtained with a heavy-grade fuel oil applied at the rate of ¼ gal. per square yard. From ⅛ to ¼ in. of sand was applied to blot the oil and then broomed to obtained a uniform coat. The cost of the oil-mixed surfacing in place was as follows:

	Cost Per Ton
Rock production and plant	$0.897
Mixing	0.197
Hauling	0.564
Spreading and compacting	0.132
Subgrading	0.200
Total cost	$1.990

This is only the cost of erecting, dismantling and operating, since the contractor used very old equipment for which no charge was made. The oil was furnished

FINISHING THE SURFACE TO GRADE
There were no traffic restrictions during or after placing surfacing.

by the state and its cost is also not included. The costs are stated in terms of tons because the several thicknesses used make the cost per mile a variable quantity.

There were no restrictions whatever in regard to keeping traffic off the oiled surfaces—in fact, traffic was allowed to go through the work during the placing and spreading of the surfacing material.

The work was done under general contract to the Southwest Paving Company and was performed under the direction of the State Highway Commission, C. H. Purcell, chief engineer. S. V. Cortelyou is district engineer in District VII, where this work was done.

Diverting the Brazos River to Improve Freeport Harbor

Continual Shoaling Hampers Navigation—Dam Will Convert Part of Old Channel Into a 7-Mile Arm of the Gulf of Mexico

DIVERSION of a large river to a new coast outlet and closure of its channel by a dam to transform its old lower portion into an arm of the sea, thus freeing navigation from troubles with floods, shoals and bars, is an unusual type of engineering work now under way for the improvement of the inland port of Freeport, Tex. This city is on the Brazos River and about 6 miles from the Gulf of Mexico. Fig. 1 shows the dredging of the diversion channel and Fig. 2 is a view of the completed channel in the rear of the dredge.

Development of Inland Harbor—The Brazos River is subject at nearly all seasons of the year to floods that bring down large quantities of silt which are deposited in the harbor and channel and upon the bar at the river mouth. Such floods cause rapid shoaling, so that vessels destined for Freeport sometimes must be diverted to other ports because the harbor is inaccessible. In one case the channel depth was reduced from 18 ft. to 11½ ft. in six days, and only by prompt action was a vessel taking cargo got out to sea while the channel was still navigable.

Two rubble-mound jetties at the month of the river were built under the direction of E. L. Corthell and George Y. Wisner, as engineers for a private company, and on the completion of their works the port was declared open in 1891. This company turned over the jetties and other improvements to the federal government in 1899, but the great storm of 1900 filled the dredged channel and little work was undertaken until 1917, when the river and harbor act provided $455,000 for improvements during a period of three years.

Owing to the continual difficulty and expense of maintaining a channel under the conditions outlined above, a recommendation for the abandonment of the project was made to the War Department in 1923 by the Chief of Engineers, U. S. Army. Strong protest was made, and after a civilian board of engineers had recommended the diversion project Congress, in 1926, appropriated $500,000 toward the expense of this work. At the same time Brazoria County, in which Freeport is situated, voted a bond issue of $1,000,000 to assist this project, and the Brazos River Harbor Navigation District of Brazoria County was created. The bonds were sold in 1927, after a suit to determine their validity had resulted in a decision favorable to the district.

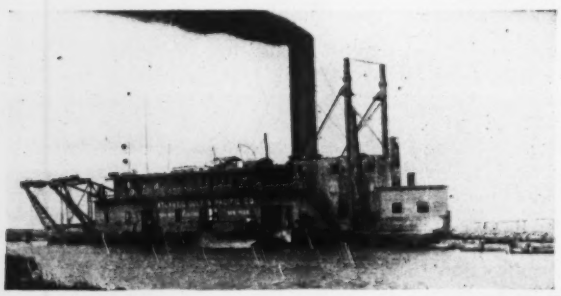


FIG. 1—DREDGING DIVERSION CHANNEL FOR THE BRAZOS RIVER

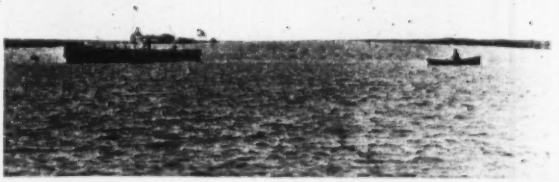


FIG. 2—BRAZOS RIVER DIVERSION CHANNEL. View from rear of dredge, about a mile inland from coast

Harbor Improvement Project—Under the project now being carried out, and shown in Fig. 3, a dam will close the river channel about 1½ miles above Freeport, and just above this dam will be the entrance to the diversion channel, 6 miles long, discharging into the Gulf about 5 miles southwest of the river mouth. When these works are completed, the harbor at Freeport will be deepened and improved by the construction of piers and wharves. The federal government will straighten the old river channel, which will then be a tidal harbor and will provide a depth of 22 ft. of water. Further deepening to 25 or 30 ft. is proposed. It is expected that various industries will be located along this channel, as has been done on the ship channel at Houston, Tex. They would be served by the Houston & Brazos Valley Railway, a subsidiary of the Missouri Pacific Railroad System.

The dam across the Brazos River will be an earth fill of large section and flat slopes, composed largely of clay dredged from the throat of the diversion channel. A core wall of interlocking steel sheet piling will extend 34 ft. below and 12 ft. above mean low-tide level. Several brush retards will be built on the east side of the river, just above the dam, to divert the current toward the new channel and thus protect the dam from erosion. A lock in this dam has been proposed but is not included in the present plan or contract.

Diversion Channel—In the 6-mile diversion channel, now being excavated, the upper end for a distance of 2,700 ft. will have a bottom width of 450 ft., providing a section equal to or greater than that of the natural river channel. For the next 22,000 ft. the width is reduced to 250 and 200 ft. Below this, for about 1¼ miles and extending to the coast, the bottom width is increased to 400 ft. The depth of the channel will be uniformly 12½ ft. below mean low-tide level. Typical sections of the dredged channel, showing also the floodway and levees, are shown in Fig. 4, while Fig. 2 shows the completed channel at its lower end.

Levees of dredged material are built on both sides of the channel and approximately 2,000 ft. apart, the space between them forming a floodway of sufficient capacity to carry a flood of 70,000 sec.-ft., with a freeboard of 4 ft. from the flood line to the 12-ft. crest of the levee. In the highest flood on record, that of 1913, the esti-

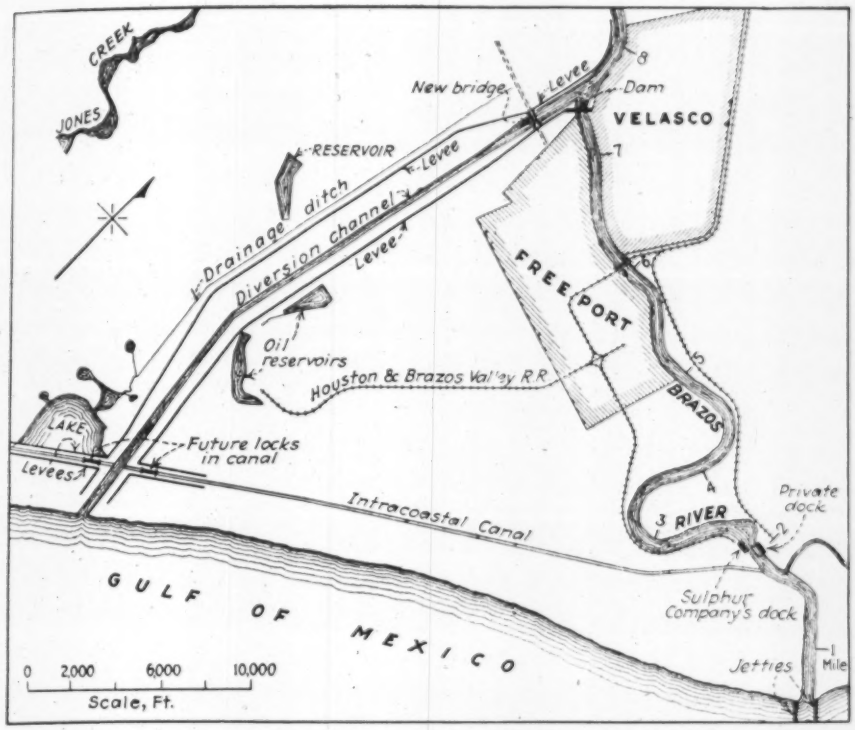


FIG. 3—RIVER DIVERSION FOR HARBOR IMPROVEMENT AT FREEPORT, TEX.

mated discharge was 65,000 sec.-ft. Except at the upper end of the channel the levees are of large section with long flat slopes, as shown in Fig. 4.

If an exceptional flood should occur, beyond the capacity of the floodway, the water will spill over the west bank of the river, above the entrance to the channel, inundating low marshy land of comparatively small value. To provide for such overflow, there will be no levee on this part of the west bank of the river, which will thus serve as a spillway. On the east side, however, there will be a levee extending from the dam to high ground about 11 miles upstream.

At its upper and lower ends the channel will have sufficient cross-section to carry flood flows with little or no scouring. In the narrower stretch, with 250 and 200 ft. bottom width, the cross-section of the excavated channel will not be equivalent to that of the old river channel, the expectation being that the current will scour it out to the necessary extent and possibly make some changes in the alignment. Although it was foreseen that some future corrective work may be necessary in this part of the channel, it was considered that this would be cheaper than to dredge the channel to greater dimensions in the first place. In fact, the dredged channel is really a guide channel, and the river, after its diversion, is expected to scour for itself a channel of adequate dimensions.

There will be no jetties at the mouth of the channel, and it is expected that the velocity of flow will be such that the silt brought down by the river at flood times will be carried out into deep water of the Gulf instead of building up a bar, as is the case at the present natural outlet. This new channel lies almost entirely through the low marshy ground characteristic of the Gulf coast, its surface being only about 2½ ft. above normal low tide. Excavation, which will amount to about 5,500,000 cu.yd., is being done by a large hydraulic dredge, shown in Fig. 1. It began operations on the coast and cut its way through the beach to the low ground behind. The material, mainly mud and clay, is discharged through a floating pipe line to form the levees.

Highways and Canal Crossings—A main state highway entering Freeport from the west will be intersected by the diversion channel. In preparation for this, a bridge has been built in advance, the work being simplified by being done on dry land. This bridge, built at the expense of the Navigation District, is 610 ft. long, including a 250-ft. swing span (Fig. 5) and two fixed truss spans. Its design was approved by the U. S.

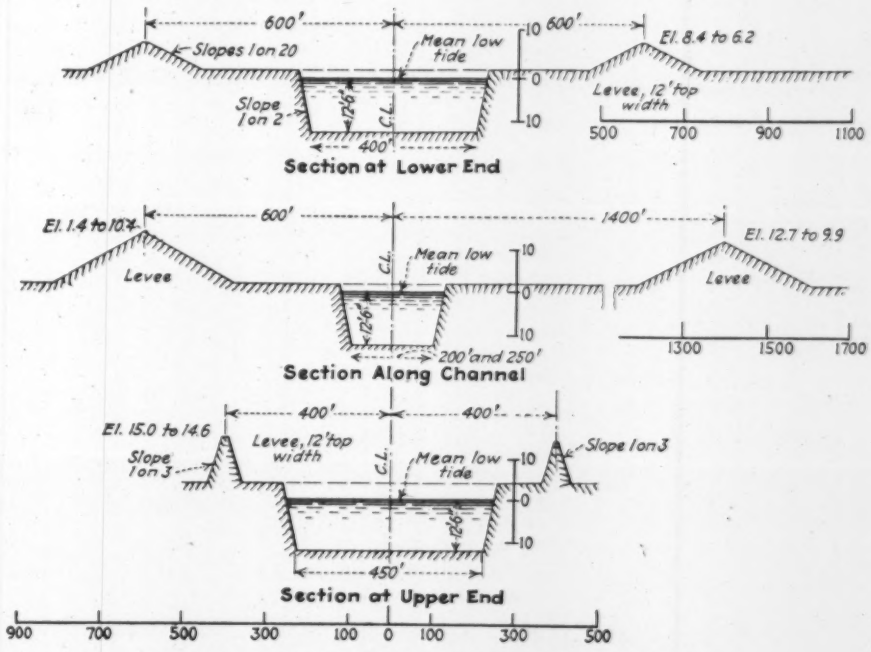


FIG. 4—TYPICAL SECTIONS OF DIVERSION CHANNEL

FIG. 5—SWING SPAN BUILT OVER LOCATION FOR DIVERSION CHANNEL

War Department and the Texas State Highway Department. The latter will maintain and operate the bridge.

An interesting and rather critical feature of the new channel is that it will be intersected near its mouth by the proposed Intracoastal Canal, which is to parallel the coast line of the Gulf. To prevent silting of this canal, the river diversion plans provide for guard locks on each side of the diversion channel, their cost to be defrayed by the federal government.

Engineers and Contractors—Development of the Freeport harbor is under the management of the Brazos River Harbor Navigation District, of which Edward C. Tobey, of Freeport, Tex., is chairman. The river diversion project was proposed and the general plan prepared by J. F. Coleman, New Orleans, La., as consulting engineer for the district. These original plans, with some modification, were accepted by the U. S. Engineers when the project was taken over by the federal government. The dredging and dam construction now being done are under the direction of Major Milo P. Fox, Corps of Engineers, U. S. Army, who is U. S. district engineer, stationed at Galveston, Tex. The work of improving the old river channel is also in his charge.

For the channel excavation and construction of the dam the contract was let to the Atlantic, Gulf & Pacific Dredging Company, Houston, Tex. The highway bridge, designed by Harrington, Howard & Ash, Kansas City, Mo., was built by the Tellepson Construction Company, Houston, Tex., under contract from the district. There is available about $1,500,000 for the entire project. The cost of the dam and diversion channel is estimated at $1,100,000, of which the federal government will pay $500,000 and the remainder will be paid by the Navigation District. The latter will pay for the construction of the bridge and will then turn it over to the state highway department. These estimates are considered liberal, and it is expected that there will be an unexpended balance which may be applied on the harbor improvement work.

Life of Modern Building Set at 30 Years

That the probable life of a modern steel skeleton fireproof office building does not exceed 30 years is stated in the report of the taxation committee of the Building Managers and Owners Association of New York City. The report is based upon a study of all office buildings on Broadway south of Cortlandt St. The land on which these structures stand is valued at $11,000,000, and it is stated by the committee that an acre and a half of the buildings more than 25 years old now in this area add nothing to the value of the land.

Yankton Abandons Artesian Wells for Missouri River

Water Supply High in Hardness and Iron Given Up for Soft Water From River With Intakes in Bridge Piers

By F. G. Brueckmann

Associate Engineer, Burns & McDonnell Engineering Company, Kansas City, Mo.

After more than 40 years of dependence on artesian wells the city of Yankton, S. D., is about to change to the Missouri River as a source of water supply, thus substituting soft water for hard water, high in iron content. The intakes for the new supply will be located in bridge piers. Low-service turbine pumps will be used. The delivery main will be laid on a drawspan opened only once a year for testing the draw.

Artesian wells have always been the source of the municipal water supply at Yankton. Water was struck in the first well drilled there on Sept. 8, 1881. The first city well of record, known as the West Side well, was drilled for a depth of 800 ft. for a 6-in. casing and then explosives were used to deepen the well to a 92-ft. depth, the size of the casing being reduced to 4 in. At this depth a good flow of water can be obtained from the Dakota sandstone formation. Most of the borings in the Yankton region are in the Niobrara chalk rock, pass into the Benton group at depth of 50 to 200 ft., and after penetrating about 300 ft. of this formation reach Dakota sandstone.

The present supply depends entirely on two wells not more than 150 ft. apart. These wells register a positive static pressure of 13 lb. at the suction of the pumps, dropping to 10 lb. with a discharge of 450 g.p.m. and to 8 lb. with a discharge of 750 g.p.m. The supply has always been ample for the city's needs with the exception of three to five days of peak consumption each year during the irrigation season, and could be easily augmented by the sinking of additional wells.

The artesian water at Yankton, as is the case with most deep artesian flows, is highly mineralized. An unusually large amount of hardening salts, including a very appreciable and objectionable amount of iron, are present, as shown by the accompanying table, based on analyses for probable hypothetical combination of mineral salts, from which it appears that the total hardness was 960 p.p.m., of which 830 p.p.m., or 86 per cent, was permanent. The large iron content indicated was evidenced by stained plumbing fixtures all over the city.

For many years there had been some agitation at Yankton for a softer water supply, free from iron.

MINERAL SALTS IN ARTESIAN WELL WATER AT YANKTON, S. D.

	P. P. M.	Grains Per U.S. Gal.		P. P. M.	Grains Per U.S. Gal.
Iron bicarbonate	4.8	0.29	Uncombined insol.	20.0	1.20
Calcium bicarbonate	205.4	12.32	Hardness due to various salts, in terms of calcium carbonate ($CaCo_3$):		
Magnesium bicarbonate	0.0	0.00			
Sodium bicarbonate	0.0	0.00	Lime	734.3	43.9
Manganese bicarbonate	0.7	0.04	Magnesia	222.5	13.3
Calcium sulphate	827.6	49.65	Iron	3.1	0.19
Magnesium sulphate	267.9	16.07			
Sodium sulphate	38.8	2.33	Total hardness	959.9	57.44
Calcium chloride	0.0	0.00	Temporary hardness	129.8	7.76
Magnesium chloride	0.0	0.00	Permanent hardness	830.1	49.68
Sodium chloride	138.6	8.32			

Some of the water users objecting to the present supply, however, would have been sufficiently relieved if the artesian water had been treated for iron removal only. As a result a detailed study was made of this possibility.

The basic principle of deferrization of water is the removal of iron by oxidation and precipitation. Iron-bearing waters may be classified as those in which (1) the iron coagulates and precipitates immediately after aeration; (2) only a part of the iron precipitates on aeration and a part is held in a colloidal or finely divided state indefinitely; and (3) in which all the iron as ferric hydroxide remains in a colloidal state for an indefinite time after aeration. The first class can be easily treated and the iron removed by aeration and sedimentation or aeration and filtration, or by the use of all three. The second class requires the use of aeration and a light treatment with lime or other chemicals preliminary to sedimentation or preliminary to sedimentation and filtration. Waters of the third class require a more complex method of treatment due to substances such as carbon dioxide, organic matter and manganese which are contained in the water and in most cases must be eliminated before iron can be removed. Preliminary field experiments followed by complete chemical analyses in the laboratory placed the Yankton supply in the second class. Aeration, followed by a small amount of lime treatment prior to sedimentation, was considered essential for the successful removal of iron from this supply. However, with all of the iron removed, a satisfactory water would not result, because of the high percentage of hardening salts present.

Preliminary figures indicated clearly that it would be uneconomical and impracticable to attempt to soften this artesian supply, the estimated cost approximating 15c. per 1,000 gal. just for the necessary chemicals and their application. These figures were based on reducing the total hardness of 960 p.p.m. to a residual hardness of 100 (total). Besides, any attempt at getting a satisfactory water from this source of supply by a softening process would be ineffectual. The permanent or sulphate hardness would merely be converted into glauber salts, which are soluble in water. Such large amounts of glauber salts in solution would have a decided cathartic action on the human body and would cause excessive foaming in boilers. This is a pertinent factor to be considered in water softening, when the supply has a high percentage of sulphate hardness.

A hard and fast rule to fix certain "standards" of quality and purity for a municipal water supply is an impossibility, as results that would be admissible in one place would be very unsatisfactory in another. In fact, the public or the water consumer fixes within certain limits the standard of quality of a water supply, and the standards change with public opinion. The public is considering more and more the economic and financial value of the water it must now put to a large variety of uses.

At Yankton it was considered desirable to submit the question of future supply to a referendum of the voters (who are, and represent the water consumers). Two proposals were submitted to the voters in the spring of 1928, one providing for the continuance of the present artesian supply, treated for iron removal only; the other for the abandoning the artesian supply in favor of an entirely new sources of supply from the Missouri River. In face of the ever-increasing demand for a much softer water than could be obtained from the present artesian wells, the Missouri River was adopted as the source of the new supply. This stream offers an inexhaustible supply of relatively soft water—soft at least when compared with the unusual hardness (960 p.p.m.) of the artesian supply. Filtration followed by chlorination was considered essential in the treatment of the Missouri River water for a domestic supply.

Local conditions, however, dictated certain forced economies in the functional design of the improvements. The people in favor of Missouri River water sponsored the use of vertical shaft openings left in the bridge piers of the Meridian highway bridge at Yankton for low-service intakes and as substitutes for filters. In setting the amount of the bond issue for the Missouri River proposal, the cost of a filter building as provided for in the original estimate of the engineers was omitted.

Certain unusual features of the design as finally laid out should be of general interest and will be presented briefly. Intake shafts were provided for in five of the piers of this bridge at the time the bridge was built. These intakes consist of vertical shaft openings 2 ft. in diameter, extending from the top (or the bearing plane for the bridge superstructure) to the bottom of the piers. There are inlet openings into these shafts at two different elevations. The upper openings are located just below mean low water and are designed to let in channel water, whereas the lower openings are below the streambed and are designed to let in water from the gravel stratum below the river. The upper intakes have passages 2 ft. wide and 5 ft. high on the downstream side of the piers, leading from the outside of the piers to the shafts. A heavy coarse screen was built over this opening near the outside of the pier. The lower intakes have three passages 2 ft. wide and 10 ft. high, one each from the downstream and from the two sides of the piers, leading from the outside of the pier to the vertical shaft openings. These lower passages each have two screens, one near the outside of the pier and one near the central shaft, with coarse gravel between the two screens. The object of the lower openings was to let "filtered" water into the central shaft well.

FIG. 1—VIEW OF BRIDGE PIERS USED AS WATER INTAKES FOR YANKTON

The only satisfactory way to obtain water from these piers would be by means of deep-well turbine pumps, as the suction lift from the top of the pier to the low-water stage of the river would be too great to permit operation of horizontal centrifugal pumps. The diameter of these intake shaft openings, as well as the limited space available on the edge of one of these piers, automatically allowed the use of only one pump on each pier. Since it was desirable to have more than one low-service pumping unit, it was necessary to make plans to utilize

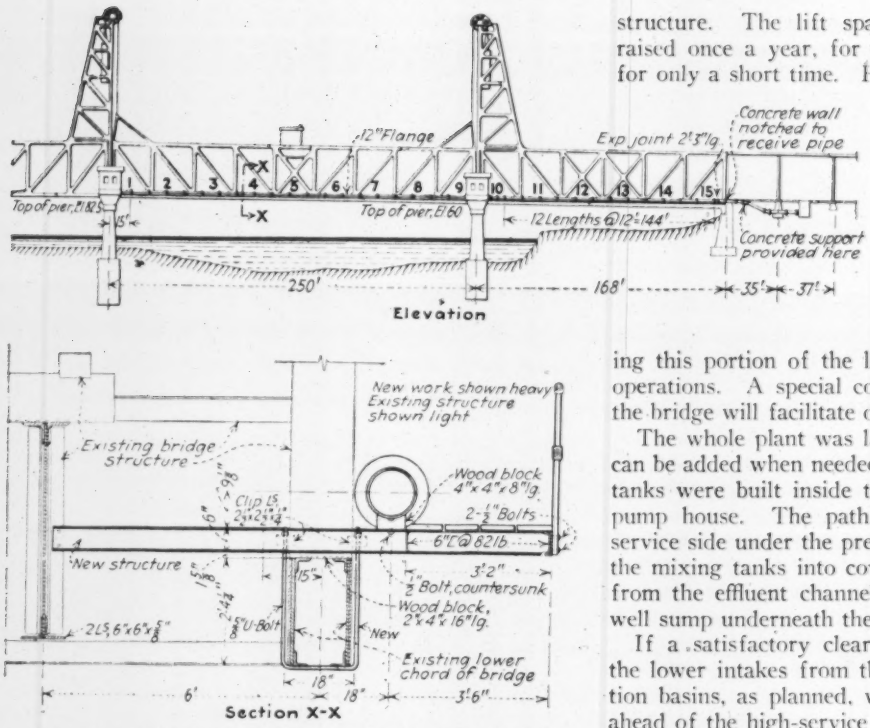


FIG. 2—METHOD OF SUPPORTING WALKWAY AND FORGE MAIN FROM WATER INTAKES IN BRIDGE PIERS

at least two piers. This necessitated crossing the lift span of the bridge with the discharge piping.

Fig. 1 is a view of the bridge looking downstream. The lift span and the approach to the bridge from the Yankton side are clearly shown in this illustration. This is a two-deck bridge. The upper deck is used for a toll highway crossing. The lower deck was built for railroad traffic, but to date has not been used for this service.

Fig. 2 is an elevation of the low-service pump houses and the pipe and walk support leading from these houses to the Yankton shore with the outline of the bridge in the background. This elevation was drawn for a view looking upstream, as the intake openings in the bridge piers were built on the downstream side of the piers.

It was thought highly desirable to have ready access to the pump houses on the bridge piers, and as a result a combination pipe support and walkway was designed projecting downstream beyond the bridge trusses. The main channel beam supports for this walkway cantilever beyond and rest on the lower chord of the bridge and are bolted to the stiffener angles of the floor beams of the lower deck. The bridge was constructed so that the lower chord would clear the maximum ice gorge elevation in the river channel. By supporting the walkway beams on top of the lower chord, the pipe and walkway were removed from any possible destruction from ice gorge conditions.

Expansion joints in the pipe line are provided for on both sides of the lift span of the bridge. These will allow for expansion and contraction due to temperature changes and will also permit ready uncoupling of the pipe when the lift span is raised. The walkway for the length of the lift span is not connected to the walkway on either side of this span, so that when the expansion joints are uncoupled the pipe and walkway for the length of this span can be raised with the bridge structure. The lift span of the bridge is ordinarily raised once a year, for test purposes, and is left open for only a short time. However with one pump located on the Yankton side of the lift span, uninterrupted pumping service could be maintained even with this span raised.

It is proposed to eliminate probable freezing of the low-service discharge piping on the bridge structure during severe cold weather by draining this portion of the line immediately after pumping operations. A special control manhole on the shore at the bridge will facilitate draining all exposed piping.

The whole plant was laid out so that a filter building can be added when needed. Mechanical chemical mixing tanks were built inside the combination headhouse and pump house. The path of the water from the low-service side under the present layout would lead through the mixing tanks into covered sedimentation basins and from the effluent channel of these basins to the clear-well sump underneath the high-service pump room floor.

If a satisfactory clear water can be obtained from the lower intakes from the bridge piers, the sedimentation basins, as planned, will serve as clear-well storage ahead of the high-service pumps. The basin design will permit water to be taken off on the effluent side either at the top by a weir channel or direct at the bottom into the pipe line leading to the clear-well sump.

Provision for equipping the chemical tanks has been postponed until the extent of the necessary treatment is determined. If it becomes necessary to treat channel water, the mixing tanks will need to be equipped, dry-feed machines purchased and filters constructed, to give a safe and satisfactory water for domestic consumption. In either event provision is made for chlorination of all the water coming into the clear-well sump.

The location for the projected treatment plant is in the city's Riverside Park near the highway bridge. The only part of the plant that will show above the finished ground level will be the one story of the combination head house and pump house on the north, east and west, and the first floor and basement floor on the south side or riverfront. The main or front entrance is on the north side, with a rear entrance direct to the basement or high-service pump room floor on the south. Sufficient light and ventilation for the pump room are provided for in the south exposure of the basement wall.

Contracts were let on Sept. 11, 1928, to Ellerman & McLain, of Yankton, and to Ohlsen & Sons, of David City, Neb., for the construction of these improvements. The Burns & McDonnell Engineering Company, of Kansas City, Mo., and Los Angeles, Calif., is the engineer.

Australian City Exacts Fee for Parking

Melbourne, Australia, is putting into effect a system by which certain streets in the business section of the city will contain parking areas, for the use of which the city will charge fees ranging from about 25c. for a day to $50 for a year. Cars will not be allowed to remain for more than fifteen minutes in any other portion of the downtown district. The system applies only to business hours, unrestricted parking being permitted at night and on Sundays and holidays.

Agricultural Value of Nile Silt Held Fallacious

Summer Fallow, Not Silt Deposit, Maintains Soil Fertility, So Need Not Clog Canals to Get Silt to Land

By E. McKenzie Taylor

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In Many Ways the deltaic plain of Egypt resembles Imperial Valley, California. Both are the creations of silt-laden streams. Each is characterized by extreme aridity, mild winters and hot summers, a growing season continuous throughout the year, fertile soil when artificially watered, and a wide diversity of the same kind of crops. The main difference, from an agricultural engineering standpoint, is in the treatment of silt. From the time of the Pharaohs to the present, Nile silt has been considered necessary to maintain soil fertility, and engineers have designed and constructed irrigation works with the object of transporting the river silt to the land irrigated. In Imperial Valley, development agencies have expended millions of dollars to get rid of silt. Dr. McKenzie Taylor is one of the first high authorities to question the agricultural value of Nile silt, and if further experimentation should corroborate his findings, the effect would probably be far-reaching not only throughout the Nile basin but in India, Siam, Java and elsewhere. The general acceptance of his view would serve also to justify the course followed by American engineers in the reclamation of desert lands in Imperial Valley, California, and in the northern portion of Baja California in Mexico.

—Editor.

A QUESTION of considerable importance in connection with the economic operation of an irrigation system is raised by Fortier and Blaney in their discussion of the silt problems of the Colorado River. ("Silt in the Colorado River and Its Relation to Irrigation," by Samuel Fortier and Harry F. Blaney. Technical Bulletin No. 67, Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture, Washington, D. C. February, 1928). They state (p. 44) that

> . . . it [Kennedy's silt theory] is of no practical value to the farmers and canal operators of Imperial Valley. Kennedy's purpose was to transport the entire silt load through the canal system and dump it into the field ditches and on the fields of the Hindu farmers. . . . They [the farmers of Imperial Valley] have learned from costly experience that it is much cheaper and easier to dispose of as much as possible of the inflowing load of silt at or near the intake than to take care of it after it reaches the farms. . . . In other words, the landowners of Imperial Valley are seeking relief from the present burdensome silt nuisance in a manner directly opposed to that recommended by Kennedy to the government of the Punjab for the canals of that territory.

One of the main reasons for carrying silt in canals is the supposed fertilizing value of the silt and its use in maintaining soil fertility. The description of the silt as a nuisance and the suggested desilting of the water before it enters the canals are, therefore, opposed to present-day ideas on these questions. The object of the present article is to examine the suggestions in the light of the results of some Egyptian investigations on the agricultural value of Nile silt.

The value that has been attributed to river silt as a fertilizer probably originated from the classical example of the Nile Valley and delta. In the course of investigations on the decline in yield of cotton under perennial irrigation, it became necessary to consider the agricultural value of Nile silt, as it had been suggested that the decline in soil fertility could be atributed to the fact that the land does not now receive the annual deposit of silt which was characteristic of the basin system of irrigation. The results obtained in this investigation are given, as they may be of interest and value because they support the statement made in the foregoing quotation.

History of Irrigation in Egypt

To appreciate the changes that have taken place in irrigation and agriculture in Egypt, it is necessary to deal briefly with the history of irrigation in that country. From an agricultural point of view, Egypt is rainless except in the neighborhood of the Mediterranean coast. The production of crops in Egypt has, therefore, always been dependent for water supply upon a system of irrigation. One of the chief characteristics of the Nile is the annual flood, due to rain on the Abyssinian plateau. The flood begins to reach Cairo at the end of July and is at its height about the end of September. The first type of irrigation used in Egypt was known as basin irrigation. The land was divided into a series of basins by means of dikes. The floodwater was led by natural channels or artificial canals into the basins and allowed to stand in them for 45 days. The retention of the water in the basins for this length of time resulted in the thorough saturation of the soil, and at the same time the silt held in suspension was deposited. At the end of the 45 days—that is, in November—the water was run out of the basins into the river and the land sown with winter crops. The crops were dependent for their water supply on the subsoil water left as the result of the inundation. The crops were harvested in April and May, after which the stubbles remained fallow until the following flood period in September.

One of the main features of the basin system of irrigation was the maintenance of soil fertility as indicated by the constancy of the crop yield. Two characteristics of the basin system of irrigation may have been responsible for the maintenance of soil fertility: (*a*) the annual inundation during which the land received a deposit of Nile silt; (*b*) the annual fallow period from May until September. Until recently it was considered that the main factor responsible for the maintenance of soil fertility under the basin system of irrigation was the annual deposit of Nile silt. Recent investigations have shown, however, that the cause of the maintenance of the fertility of the soil must be sought in the annual fallow period.

Until 1820 such irrigation as was practiced in the Nile delta was of the basin type. The possibility of

growing cotton in Egypt was at that time recognized by Jumel. As cotton could be grown only as a summer crop, a water supply was necessary for irrigation. Perennial irrigation was, therefore, introduced in 1820 with the object of growing cotton. The Nile is low during the summer period and the channels used for filling the basins were not deep enough to carry water at the low stage of the river. The first step, therefore, in the development of the system of perennial irrigation was the deepening of the channels to take the low-level summer water of the Nile. These channels had two objections: (1) all the water used for irrigation had to be lifted through a considerable height on to the land, and (2) the canals used to silt up during high water, necessitating an annual clearance which entailed the use of a large amount of labor.

To overcome the former of these difficulties, the construction of the delta barrages was sanctioned. The barrages were commenced in 1835 and were first used in 1861, but owing to difficulties that arose they were not of great value to irrigation until 1884. From 1820 to 1884 perennial irrigation was practically maintained by the annual clearance of the deep canals by forced labor. The main developments in the perennial irrigation system have taken place since 1884. In that year both barrages were used for the first time. In 1891 repairs to the barrages were completed, and they held up 13 meters of water on the gage. Between 1891 and 1900 the barrages held up 14 meters and since 1901, 15.5 meters on the gage. The main result of increasing the amount of water held up at the barrage has been to convert the country from lift to flush irrigation. Since 1901 the perennial irrigation system in Egypt has undergone two further developments: In 1903, the water stored by the Aswan dam was added to the summer supply of the Nile, and in 1906 it was decided to raise the Aswan dam so that more water could be stored; this additional supply was added to the river in 1912.

Changes Caused by Modern Development

From the foregoing sketch it will be seen that two main changes have taken place: (1) The land is now irrigated instead of inundated and so does not receive the annual deposit of Nile silt; (2) the summer fallow has been eliminated from the agricultural system and summer cropping substituted. To the reduction in the amount of silt received has been attributed the decline in soil fertility.

River silt may be regarded from two points of view: (*a*) as a soil former, (*b*) as a soil fertilizer. Its value as a soil former is unquestioned, but its value as a soil fertilizer appears to be based on statements which have not the foundation of experimental verification. From the earliest times Nile silt has been regarded as a fertilizer, and the importance attached to it is evidenced by the following statement of Colonel Ross, the first inspector-general of irrigation in Egypt: "The greatest calamity which could overtake any part of Egypt would be a red-water famine." (Red water is floodwater rich in silt.) Sir William Willcocks is equally emphatic and deals with the subject on numerous occasions in his book "Egyptian Irrigation." The literature dealing with agriculture and irrigation in Egypt contains numerous references of a similar character to that quoted as to the fertilizing value of Nile silt. As a result of the dictum of Colonel Ross every effort has been made in designing irrigation works to insure that the silt carried by the river during the flood period shall reach the fields. As stated by Fortier and Blaney, Kennedy's silt theory was elaborated with the object of delivering the silt to the fields of the farmer. This attempt to carry the silt to the fields has resulted in the silting of canals and ditches, the clearance of which is a heavy burden on the finances of both the individual and the country.

The value of Nile silt as a fertilizer does not appear to have been questioned. A survey of the literature does not reveal one instance of an investigation of its fertilizing properties. The statements as to its fertilizing value are not the result of experimental investigation but are opinions which have been so often expressed that they are now accepted as facts. If Nile silt has the fertilizing properties attributed to it, these should be capable of demonstration in field experiments. Experiments were, therefore, commenced in 1921 with the object of obtaining information as to the fertilizing properties of the silt. These experiments are briefly described below.

Three types of plot were laid down, six repetitions of each type being made. The treatment of the plots was according to the following scheme:

Type A Plot:
- 1922. Maize sown June 21. Watered heavily with floodwater containing silt in August, September and October
- 1923. Cotton.
- 1924. Treatment same as 1922.
- 1925. Cotton.

Type B Plot:
- 1922. Summer fallow. Watered heavily with clear well water in August, September and October.
- 1923. Cotton.
- 1924. Treatment same as 1922.
- 1925. Cotton.

Type C Plot:
- 1922. Summer fallow. Watered heavily with floodwater containing silt in August, September and October.
- 1923. Cotton.
- 1924. Treatment same as 1922.
- 1925. Cotton.

From the above scheme it will be seen that two of the plot types have Nile silt applied as a fertilizer twice during the period, while the Type B plots have had no silt at all. If Nile silt is of any fertilizing value, the yield of Type B plots should be considerable lower than the yields obtained on the other two types. The yields of cotton obtained are shown in the accompanying table.

YIELDS OF COTTON IN KANTARS PER FEDDAN
(1 kantar = 100 lb.)

Plot Type	1923	1925
A (Silt, no fallow)	3.85	3.50
B (No silt, fallow)	4.68	4.33
C (Silt and fallow)	4.45	3.49

Conclusions

The following conclusions may be drawn from the foregoing table:

1. A dressing of Nile silt without a summer fallow does not maintain crop yield.

2. A dressing of Nile silt following a summer fallow (as in the basin system of irrigation) does not increase crop yield.

3. The summer fallow is the effective agent in the maintenance of soil fertility under perennial irrigation.

4. Nile silt is not the agent responsible for the maintenance of soil fertility and has not the fertilizing properties previously attributed to it without investigation.

As a result of these and other experiments on the same subject it was concluded that river silt cannot be regarded as a soil fertilizer and that in irrigated areas, as in non-irrigated, the maintenance of soil fertility results from a suitable agricultural system.

If river silt has not the fertilizing value previously attributed to it, it is not important that it should reach the fields of the farmer. In the past one of the main factors controlling the design of irrigation works has been the delivery of silt to the land. The carrying of the silt is not only an expensive process but also, in many cases, involves the question of continuity of water supply. If river silt has no fertilizing value, then any expense incurred in its transport is money spent for no useful purpose. As the fertilizing value of river silt has been disproved, it is no longer necessary to take the transport of the silt to the land into consideration in designing irrigation works. In place of transporting the silt some method should be substituted by which the silt content of the water can be reduced to a minimum before it enters the canal system. By so doing, the continuous expense of silt clearance from the canals and ditches would be considerably reduced and the continuity of an adequate supply of water would not be imperiled.

In the past the delivery of silt to the land has been one of the main considerations in designing irrigation works. As the silt has been shown to have no fertilizing value, the basis of the design of new irrigation works should be the reverse—that is, the design should be such that the water is desilted before it enters the artificial channels. By an alteration in this direction, the fertility of the soil would not be affected and farmers would be relieved of considerable annual expense in dealing with what Fortier and Blaney have truly called a "burdensome silt nuisance."

World-Wide Survey of Irrigation

The irrigated area of the world is 201,000,000 acres, according to a bulletin just issue by the U. S. Bureau of Foreign and Domestic Commerce. Of this acreage, 141,000,000 is in Asia. North America stands next, with 27,000,000 acres, of which more than 20,000,000 is in the United States. A summary, by continents, is given in the accompanying table. The bulletin gives like summaries, by countries, for each continent, and descriptive text for each country, with outlines of some of the larger irrigation works. Although entitled "Foreign Markets for Irrigation Machinery and Equipment," little specific information on that subject is given, although in a number of cases there is a paragraph on pumping machinery and in a few a general statement as to chances for exporters. The pamphlet may be obtained for 30c. from the Superintendent of Documents, Washington, D. C. ("stamps not accepted.")

WORLD AREA UNDER IRRIGATION BY CONTINENTS

Continent	Area (Sq.Mi.)	Population	Area Irrigated (Acres)
North America	8,685,833	157,450,526	26,834,000
South America	7,169,587	69,749,645	6,613,000
Europe	3,723,081	477,560,161	14,800,000
Asia	16,217,166	1,037,854,722	140,754,000
Africa	11,514,050	143,335,419	10,310,000
Oceania	3,307,940	9,029,300	1,270,000
Total	50,617,657	1,894,979,773	200,581,000

Winter Construction of Concrete Bridge, Springfield, Mo.

Quick-Setting Cement the Principal Factor in Rapid Work—Ground Limestone Used as Fine Aggregate

By William Judson Gray

Superintendent and Engineer, Springfield City Water Company, Springfield, Mo.

Concrete construction under severe weather conditions was accomplished this past winter at Springfield, Mo., on a reinforced-concrete highway bridge built by the Springfield City Water Company to carry a county highway over a large reservoir. The bridge was started late in December, 1928, and was finished in March, 1929.

This bridge, located about a mile upstream from the reservoir dam, is 400 ft. long and consists of twelve spans 33⅓ ft. long and of four lines of beams carrying a roadway slab 18 ft. wide. The piers are two-post bents (Fig. 1) about 28 ft. high above the footings. Each bent rests on a footing and supports a cap, while a strut 5 ft. deep is formed between the posts at mid-height. A concrete parapet wall was built after the spans were completed. It was necessary to build the bridge during the winter in order that the early spring rains could be impounded in the reservoir.

Winter Concreting—Severe weather set in early in January, just as the tops of some of the piers and caps

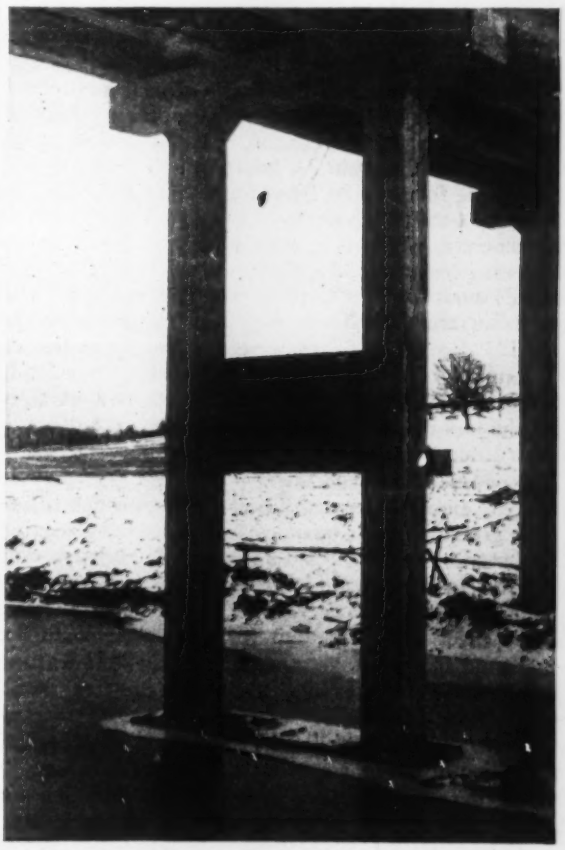


FIG. 1—TYPICAL PIER OF BRIDGE BUILT IN WINTER

were being poured. In order to reduce the hazard of freezing the concrete and to push the work during the cold spell, it was decided to use a quick-hardening cement.

Late in January, with the temperature around 25 deg. F., the first floor slab was poured, using that kind of cement. The sides of the slab were protected with tarpaulins, as shown in Fig. 2, and salamanders were kept burning underneath to insure warmth to the forms and reinforcing steel. The slab, 100 ft. in length, was poured in ten hours. Tests of the concrete in 72 hours revealed strengths ranging from 2,000 to 3,500 lb. per sq.in., depending upon the slump, which ranged from 1½ to 6¼ in. The higher slump was from the concrete used around the steel in the slab and beams.

FIG. 2—COLD-WEATHER PROTECTION OF CONCRETING

Four 100-ft. slabs were poured under similar conditions, the prevailing temperature at the time of pouring being from 25 to 40 deg. F. In two instances the temperature fell to 6 deg. below zero the evening after concrete was poured, and the following morning it was down to 16 deg. below zero, this temperature prevailing for 24 hours.

The concrete was furnished by two mixers, each using hot water and one an oil flame. The resulting temperature of the concrete in the slab ranged from 55 to 68 deg. On the curb, at the sides of the slab, the temperature was considerably lower on account of the metal forms, which were exposed to the weather.

The concrete made of the special cement had unusual workability. It held the stone in suspension so that there was practically no segregation. An inspection of the forms under the slab 24 hours after it was poured showed the forms to be free of any moisture. This was no doubt brought about by the dehydrating quality of the concrete, which is greatly intensified in the quick-hardening cement. The temperature on the surface of the slab 24 hours after the pour was 70 deg., and on the under surface (which was protected by salamanders) it was 135 deg. The forms were removed from the slab 72 hours after the pour. This meant a considerable saving to the contractor in reducing the cost of forms and the loss of time; the latter item alone cut down the construction period by at least one month.

Limestone Sand Successful—The fine aggregate for concrete, except slabs, was limestone sand, which is limestone ground by the quarries to the fineness required. That used in this work had an average fineness modulus of 2.58. In a damp and loose condition, as it came from the quarry, it had an average weight of 95 lb. per cubic foot. River sand was used for the slabs. With both river sand and limestone sand a mix of 1:2:3½ was used for the slabs and caps, and 1:2:4 for the footings and piers. The amount of water was watched carefully and changed continually depending on the moisture absorption of the limestone sand.

The experience gained from the use of limestone sand in the construction of the dam proved that concrete made with this sand is dense and almost impervious to seepage. The compressive and tensile strength of this class of concrete, which is made on a designed mix, far exceeds that of concrete made with river sand. The writer has found that in using limestone sand there are two important factors to be taken into consideration in getting good results: (1) the moisture absorption of the sand, and (2) a careful check on the mixing. The finished concrete is snow white in appearance, closely grained and almost resembles granite.

This bridge was designed by the writer and J. H. Fleming. The contractor was the Burnip Construction Company, Columbus, Ohio, whose resident engineer is E. S. Hoyt; supervision was in charge of the writer.

Hydro-Electric Progress in Canada

During 1928 the waterwheels or turbines actually installed and brought into operation in Canada totaled slightly more than 550,000 hp., bringing the total installation in the dominion to 5,328,000 hp. In addition to this increase, undertakings under construction at the end of the year totaled more than 1,200,000 hp.

The Province of Quebec stood first in works of magnitude. New plants and extensions to existing plants during the year added more than 300,000 hp. to that province's hydro-electric installation, this additional capacity being mainly found in the new Paugan plant of the Gatineau Power Company on the Gatineau River and in additional units installed at the plants already in operation at Shawinigan Falls, at Isle Maligne and at Quinze dam.

In Ontario the outstanding event of the year was the completion and the bringing into operation of the 220,000-volt transmission line between the Ottawa River and Toronto, over which power purchased by the province from the Gatineau Power Company is brought to augment the supply of the Ontario Hydro Commission's Niagara system.

The year was also notable in British Columbia, where new water-power equipment to the extent of 79,560 hp. was installed, while projects actually under construction or in early prospect involve installations which will ultimately add more than 350,000 hp. to the province's total. The West Kootenay Power & Light Company, Ltd., practically completed its 75,000-hp. development at South Slocan on the Kootenay River. The British Columbia Power Corporation was also very active throughout the year in carrying on development work through its subsidiary companies.

An Eyebar Suspension Span for the Ohio River

Stiffening Trusses on 700-Ft. Span at Point Pleasant, W. Va., Utilize Eyebar Chain as Top Chord for Half of Both Center and Side Spans—Unique Anchorage on 405 Concrete Piles

By Wilson T. Ballard

Vice-President, J. E. Greiner Company, Consulting Engineers, Baltimore, Md.

FIG. 1—THE GALLIPOLIS-POINT PLEASANT BRIDGE WITH PORTIONS OF ITS EYEBAR CABLES UTILIZED AS THE TOP CHORD OF THE STIFFENING TRUSSES

In This Article is described the first eyebar suspension bridge built in the United States which utilizes the eyebar chain for portions of the top chords of the stiffening trusses. In this respect it is similar to the Florianapolis bridge in Brazil (*Engineering News-Record*, Nov. 13, 1924, p. 778), although on the Point Pleasant bridge the suspension chains replace several panels of top chords in the side spans whereas at Florianapolis eyebar top chords are confined to the main span only. The recently completed bridge at St. Marys, W. Va., was built to the same designs as the Point Pleasant bridge. —Editor.

THE SUSPENSION bridge over the Ohio River between Point Pleasant, W. Va., and Gallipolis, Ohio, is of particular interest to engineers because it is the first of its type to be built in the United States. Its outstanding features are unique anchorages; the use of heat-treated eyebar chains, portions of which form parts of the top chords of the stiffening trusses; and the fact that there was no possibility of making any adjustments in the chains, hangers or trusses after erection.

The original design called for wire cables spun in place in the conventional manner, and the use of stiffening trusses continuous between cable-bent piers to provide a channel span 700 ft. center to center of piers with side spans of 380 ft. When the question of substituting an eyebar chain design arose it was decided to permit alternative bids on the superstructure inasmuch as the comparative cost of the two types could not be settled by means of estimates. The successful bid was on the eyebar-chain design, and the structure as completed is shown in Fig. 1. The total length of the bridge is 2,235 ft., including filled approaches. There is a 22-ft. roadway and one 5-ft. sidewalk with provision for shifting this sidewalk to brackets outside the downstream truss and thus widening the roadway to 27 ft. when the traffic requires it. The bridge was designed for an Am.Soc.C.E. H-15 loading and all bids were submitted on this live-load requirement.

The bridge connects Charleston and other points in the Kanawha River valley with Columbus and central Ohio and is owned by the West Virginia-Ohio River Bridge Company. It will be operated as a toll bridge, replacing present ferry service.

Anchorage—In order that a suspension bridge of 700-ft. span could compete in cost with a cantilever bridge it was necessary to cut to a minimum the cost of the anchorages, each of which must safely resist the 4,500,000-lb. horizontal component of the cable pull.

The ordinary gravity-type anchorage was impracticable and too expensive, first because the overlying strata of sand, gravel and alluvial deposits were unsuitable for supporting an anchorage and second because bedrock was found only at a considerable depth. An unusual anchorage was therefore designed consisting of a reinforced-concrete trough 200 ft. long by 34 ft. wide filled with earth and reinforced concrete and supported on 405 16-in. octagonal reinforced-concrete piles in which the cable pull is resisted by the weight of the anchorage and by the shearing values of the piles.

The anchorage was constructed by first making a shallow excavation into which the 15-ft. long piles were driven to a penetration of 12 ft., the upper 3 ft. of each pile later being incased in the bottom of the trough The cables were attached to steel grillages embedded in reinforced concrete near the river end of the anchorage and the entire anchorage was reinforced longitudinally so as to distribute the cable pull to all of the piles. An earth fill was then placed in the trough to give weight to the anchorage and after a settlement of this fill the concrete roadway was poured upon it.

A sufficient number of piles were used to take the entire chain pull with a factor of safety of about 2½, no consideration being given to the value of the friction between the bottom of the anchorage and the earth on which it rested. From the details of the anchorage in Fig. 2 it may be seen that the portion containing the

grillages was carried 12 ft. deeper than the rest of the anchorage. A row of concrete sheet piling was driven in the river end of the excavation for this deeper portion so as to increase the resistance of this vertical face to the pressure produced by the cable pull. The construction of these anchorages presented a simple construction problem and produced an approach 200 ft. long of excellent appearance. The river end of each anchorage includes a seat for a 75-ft. plate girder span, of which there are two at each end of the suspension bridge.

Cables—Each chain consists of heat-treated carbon-steel eyebars having an ultimate strength of 105,000 lb. per sq.in. with an elastic limit of 75,000 lb. per sq.in. and proportioned for a maximum working stress of 50,000 lb. per sq.in. The eyebars, embedded in the anchorage and connecting the splay point with the grillage, were heat treated for an ultimate strength of 75,000 lb. per sq.in. and elastic limit of 50,000 lb. per sq.in. and were designed for a maximum unit stress of 30,000 lb. per sq.in.

The eyebars are arranged in pairs, the pairs in each chain being of varying lengths depending upon their location in the bridge, in order to maintain equal panel lengths in the stiffening trusses. In each side span the chains form the top chord of the stiffening trusses for the first seven panels from the cable bent, while in the center span twelve panels of a total of twenty-eight of each truss utilize the eyebar chain as a top chord. The tension in the chains under all conditions of loading exceeds the compression in the top chord members, thus affording a factor of economy in the design similar to that in the Florianapolis bridge in Brazil.

Main Piers and Towers—The two main piers carrying the towers are of reinforced concrete with a dumb-bell cross-section consisting of two truncated cones 8 ft. in diameter under the coping with sides battered ½ in. per foot and connected by a 4-ft. reinforced-concrete diaphragm extending from the coping to the top of the footings. The footings were sunk to rock inside of double-wall steel sheet piling cofferdams.

The towers, 130 ft. 10¼ in. high, are box cross-section, fabricated in sections and erected by means of a wire-braced derrick carried up as the erection of the tower progressed. The towers are of the rocker type to permit movement due to moving loads and to changes in length of chains caused by variation in temperature. Rocking is permitted by having the bearing face of the shoe at the base of the towers planed to a cylindrical surface with radius of 20 ft., while the half of the shoe which rests on the pier has its top surface planed level.

Stiffening Trusses—The stiffening trusses are of Warren type with subverticals. The bottom chords consist

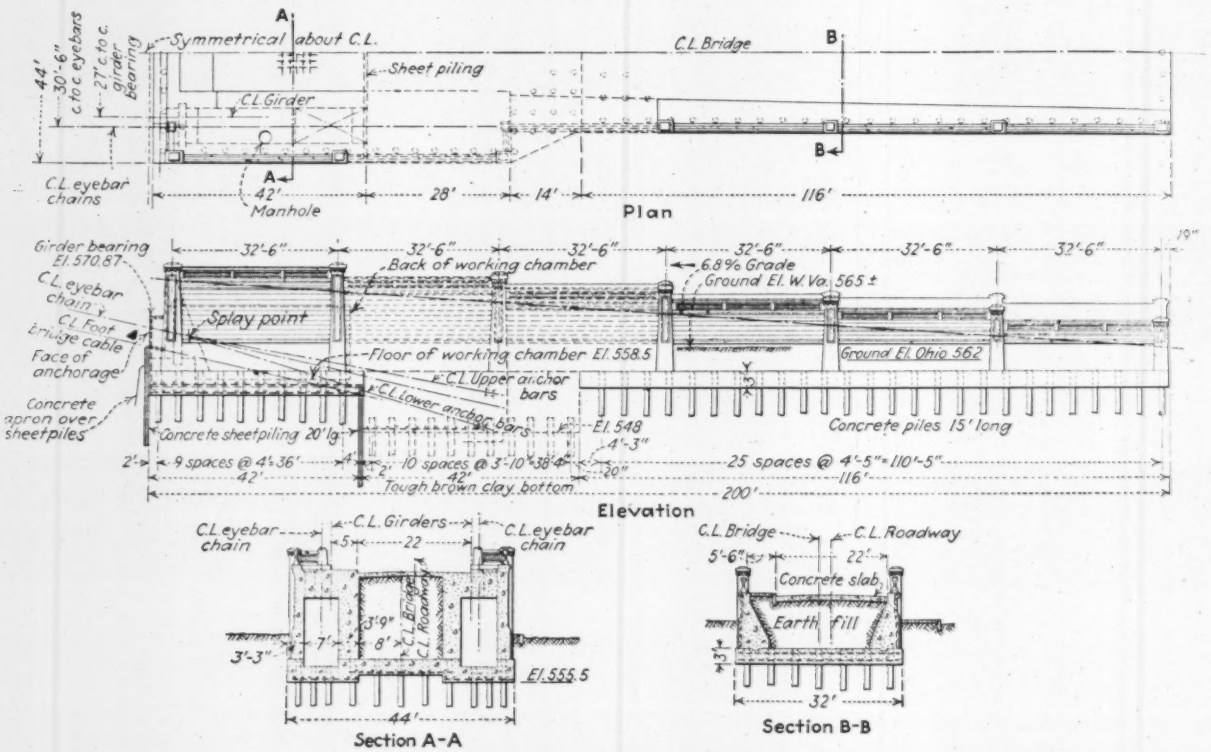


FIG. 2—DETAILS OF TROUGH ANCHORAGE

Resistance to cable pull obtained in weight of trough, which is earth filled, and in shearing strength of 405 concrete piles with their upper 3 ft. embedded in the bottom of the trough.

The towers are of the rocker type to permit movement due to moving loads and to changes in length of chains caused by variation in temperature. Rocking is permitted by having the bearing face of the shoe at the base of the towers planed to a cylindrical surface with radius of 20 ft., while the half of the shoe which rests on the pier has its top surface planed level.

Stiffening Trusses—The stiffening trusses are of Warren type with subverticals. The bottom chords consist of two 15-in. channels laced together with legs turned in. Those parts of the top chords not provided by the eyebar chains are made up of two 15-in. channels laced with legs turned out, while the diagonal members consist of 10-in. channels with legs turned in. The subverticals are made up of four angles laced with lattice bars, except where the eyebar chains form the top chords of the stiffening trusses, where 1½x6-in. eyebar hangers are used to suspend the trusses from the chains.

At all panel points where connection is made between the chains and the stiffening trusses the top chord gusset plates provide sufficient bearing for the connection pins.

Erection of the Bridge—One of the most interesting features in the designing and building of this bridge was the fact that no adjustments would be possible after

erection was complete. To provide for the possibility of a slight error in the location of the main piers the members of the center panel were not fabricated until a final check of the main span and side spans was made after the piers were compleed. The error, if any, was all to be put into the main 700 ft. span. Only $\frac{7}{16}$ in. in more than 700 ft. was found. The anchor bolt holes in the main shoes were made slotted so as to permit accurate placement of the shoes, after which the holes were closed by spot welding.

The main towers were held in a vertical position during erection by means of twelve $2\frac{3}{4}$-in. hog rods embedded in the tops of the pier blocks, three on each side of each tower leg. These hog rods were blocked out from the pier coping course and were attached to temporary plates riveted to the tower legs. They were provided with turnbuckles for adjusting the inclination of the tower.

For the erection of the eyebar chains each main tower was inclined toward the shore $7\frac{1}{2}$ in. from its plumb position and each cable-bent tower was likewise inclined $3\frac{7}{8}$ in. shoreward. These distances out of plumb were made of such magnitude that after complete erection the bridge under full dead load at normal temperature (68 deg. F.) would maintain the towers and cable bents in a true vertical position.

Erection of the eyebar chains was accomplished by assembling them on a temporary wire cable support which also carried a small erection traveler used in transporting the eyebars to their respective positions in the bridge. The eyebar chains were first erected from the splay points in the anchorage to the cable bents at each end of the bridge and in addition the riverward pairs of bars were erected at each cable bent and allowed to hang down as shown in Fig. 4.

The second eyebar pin shoreward of each cable bent was made sufficiently long to receive cast drums to which the temporary erection cables could be attached. These erection cables consisted of seven 1-in. plow steel ropes. In erecting them the first rope on each side of the bridge was attached to the drum casting by a single turn around the drum and made fast with a cable clamp. The six other ropes were then erected and adjusted to conform to the first, which had been given the proper sag. The tops of the cable-bent legs were constructed to receive these erection cables while temporary shoes were placed on the tops of the main towers, these shoes

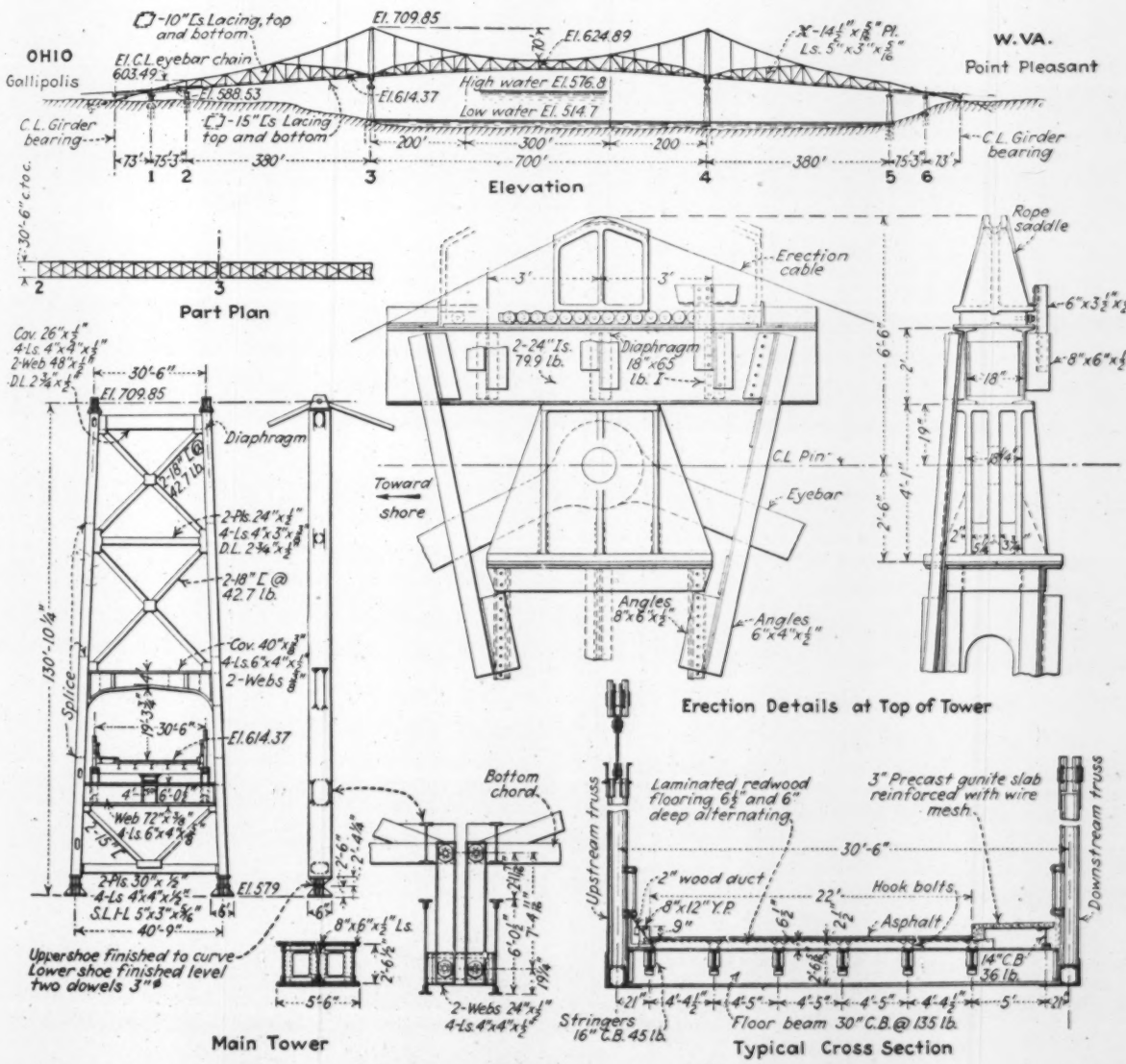


FIG. 3—DETAILS OF THE EYEBAR SUSPENSION BRIDGE AT POINT PLEASANT, W. VA.

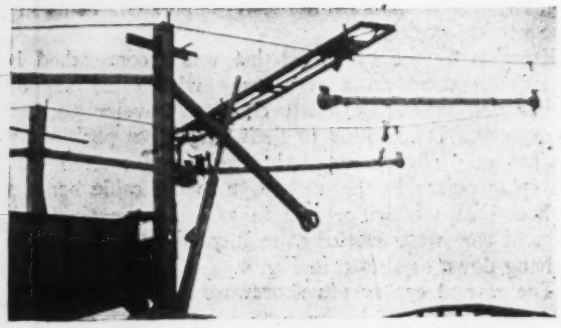


FIG. 4—START OF EYEBAR ERECTION AT CABLE BENT
Note that eyebars are in place shoreward from the cable bent and that the first pair of eyebars for the side span are being connected to the second pair suspended from the erection cable. Note also the erection travelers spanning between the temporary erection cables.

resting on rollers allowing a movement of 2 ft. on either side of the center of the tower top. Stops were provided to insure the rollers remaining on the tower. Sizings were placed on the rope strands to mark the position of the top of the cable bents and of the temporary shoes on the main towers. After erection each temporary cable was adjusted to a sag of 46 ft. in the main span, under no load except its own weight and at 68 deg. F. The sags and location of sizing markers were calculated for 68 deg. F., and 28 deg. F. For erection at any other temperature the sags and marker locations were found by interpolation.

After adjustment of the temporary cables travelers built of structural shapes and carrying grooved wheels at each end were placed on the erection cables (Fig. 4) spanning from the upstream to the downstream cable. These travelers were hauled by lines that passed through sheaves on the tops of the main towers to hoisting engines carried on barges, one moored to each of the main piers. In order to suspend the eyebars from the temporary erection cables clamps with hangers were utilized in the side span and longer link-chain falls in the main span.

Erection of the eyebars proceeded from the center of the main span toward the towers and from the cable bent towers toward the main towers in such a manner as to preserve the balance between the side spans and center span. Closures of the side and center spans were made at the pins adjacent to the main towers. In adjacent pairs of bars the ends of the bars of one pair fit between the ends of the bars of the next pair. Therefore erection was accomplished by suspending in place two pairs of close packed bars with pins inserted at each end, leaving an open panel between the pairs. This open panel was then closed by placing the connecting bars over the pins, which were champfered on the ends to act as pilots.

The eyebar chains are pinned to cast shoes carried on tops of the towers and fixed thereto so as to permit no movement. After complete erection of the eyebar chains they were swung by simultaneous slacking of the link-chain falls in the center span.

The stiffening trusses were erected in the same sequence as the links of the eyebar chains, using the travelers running on the temporary erection cables, working each way from the center of the main span and from the cable bents toward the main towers. Top chords were lifted first, followed by web members, and they in turn followed by bottom chords. In all panels where the eyebar chain formed the top chord of the stiffening trusses the gusset plates connecting the bottom chord with the web members were riveted to the chord members but were not drilled to receive the diagonals until all dead load was on the bridge. The erectors were ready to close these openings before the special rock asphalt wearing surface and sidewalk were placed. Therefore, to eliminate delay oil drums filled with water were placed on the bridge and car wheels were hung from the bottom chords at a sufficient number of panel points to place on the trusses a load equivalent in extent and distribution to the dead load of roadway, wearing surface and concrete sidewalk, including the effect of the proposed future sidewalk location outside of the downstream truss. The bottom chord being then adjusted to its proper form, all open connections for diagonal members along the bottom chord were drilled and the diagonals riveted to them, thus

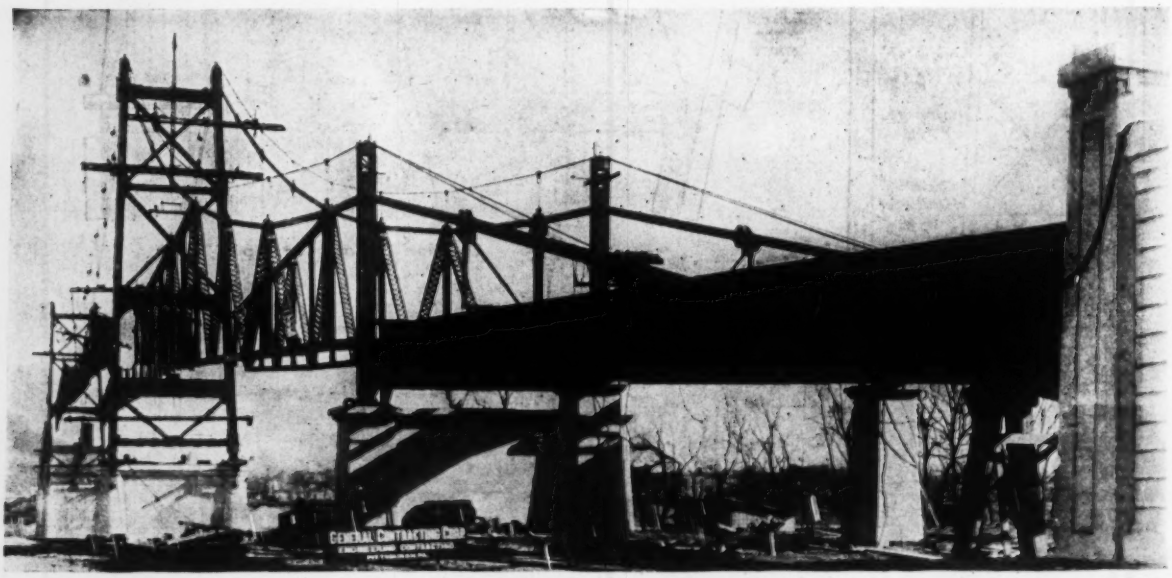


FIG. 5—ERECTING THE STIFFENING TRUSSES, POINT PLEASANT BRIDGE
Note the drums on the second eyebar pin shoreward from the cable bent to which the temporary erection cables are anchored.

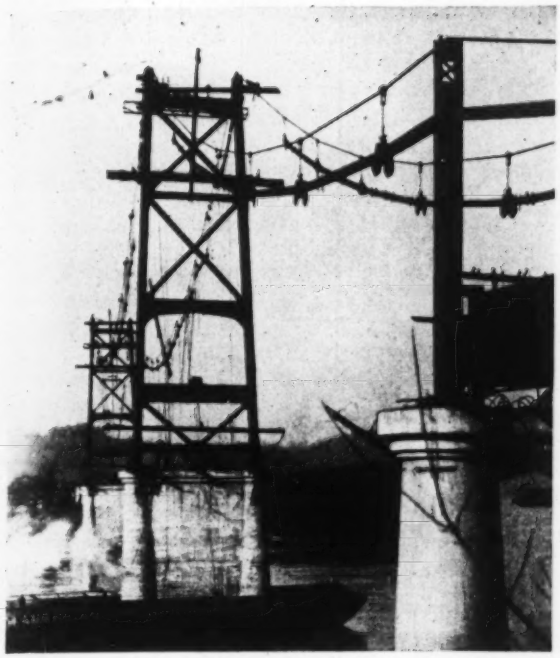


FIG. 6—EYEBAR ERECTION PROCEEDING BOTH WAYS TOWARD MAIN TOWER

Traveler is near top of main tower. Note barges on which are located the hoists which operate the travelers. A pair of eyebars is being hoisted from the barge to the traveler.

closing the trusses. After the downstream truss had been closed in this manner the water barrels and car wheels were shifted to the upstream side. The bridge was painted with aluminum paint over a shop coat of red lead and a first field coat of battleship gray.

Administration—The bridge was designed by the J. E. Greiner Company, and built under its supervision. Approximately eleven months were required for the construction of the bridge. J. Wilson Richardson was resident engineer during construction of the substructure and Charles P. Vogel served in the same capacity during the erection of the superstructure. The General Contracting Corporation, of Pittsburgh, Pa., was the general contractor and built the piers, anchorages and approaches. The American Bridge Company as subcontractor furnished and erected the steel superstructure. The Taylor-Meyer Company, of Pittsburgh, laid the laminated wood floor on the suspension bridge and the concrete slabs on the plate girder spans and the filled approaches. The Tri-State Paving Company, of Wheeling, W. Va., laid the special rock-asphalt wearing surface and the Skene-McAlpin Construction Company, of Point Pleasant, W. Va., built the toll-house.

A 40-Ft. Improved Venturi Flume

A 40-ft. reinforced-concrete improved Venturi flume "recently installed in the Fort Lyon Canal, with a carrying capacity of 1,800 sec.-ft." is characterized by M. C. Hinderlider, state engineer of Colorado, in his report for the two years ended Nov. 30, 1928, as "the largest flume of this type ever built." Mention is also made of a 20-ft. measuring flume of the same type and material, with a capacity of 700 to 1,000 sec.-ft., installed in 1927 in the Holbrook Canal, Colorado. Both flumes follow the design of the U. S. Bureau of Irrigation Investigation, Mr. Hinderlider states.

Select Site for Vehicular Tube Under Narrows at New York

Twin Tubes Proposed Following Holland Tunnel Design—Would Ask Bids on Either Shield or Trench Method

ENGINEERS of the New York City Board of Transportation and of the Department of Plant and Structures, who were directed March 15 to prepare plans for a vehicular tunnel under the Narrows of New York Bay to connect Brooklyn with Staten Island, have submitted a report to the Board of Estimate advising that the tunnel be built from the foot of 97th St., Brooklyn, to a point in Staten Island just north of Fort Wadsworth. This location, according to the report, gives the lowest cost, and at the same time is readily accessible from major traffic arteries at each end of the tunnel. The length of the under-bay portion between pierhead lines is stated at 4,700 ft.

Consideration was also given to a location between Bay Ridge Ave., Brooklyn, and St. George, Staten Island. At this site two shafts have already been constructed by the city for a proposed railway tunnel. This location was rejected because, the distance between the shafts being 10,400 ft., it was held that an additional ventilation shaft would be required in the middle of the Narrows. Besides the increased cost, estimated at $25,000,000, the approaches at each end were considered less suitable, as the location had been selected from the standpoint of railway use. It was also held that construction of a vehicular

RIVER AND CHANNEL CROSSINGS AT NEW YORK

Showing location of proposed tunnel under the Narrows between Staten Island and Brooklyn and its relation to other highway crossings.

tunnel at this site would interfere with the development of a future railway crossing.

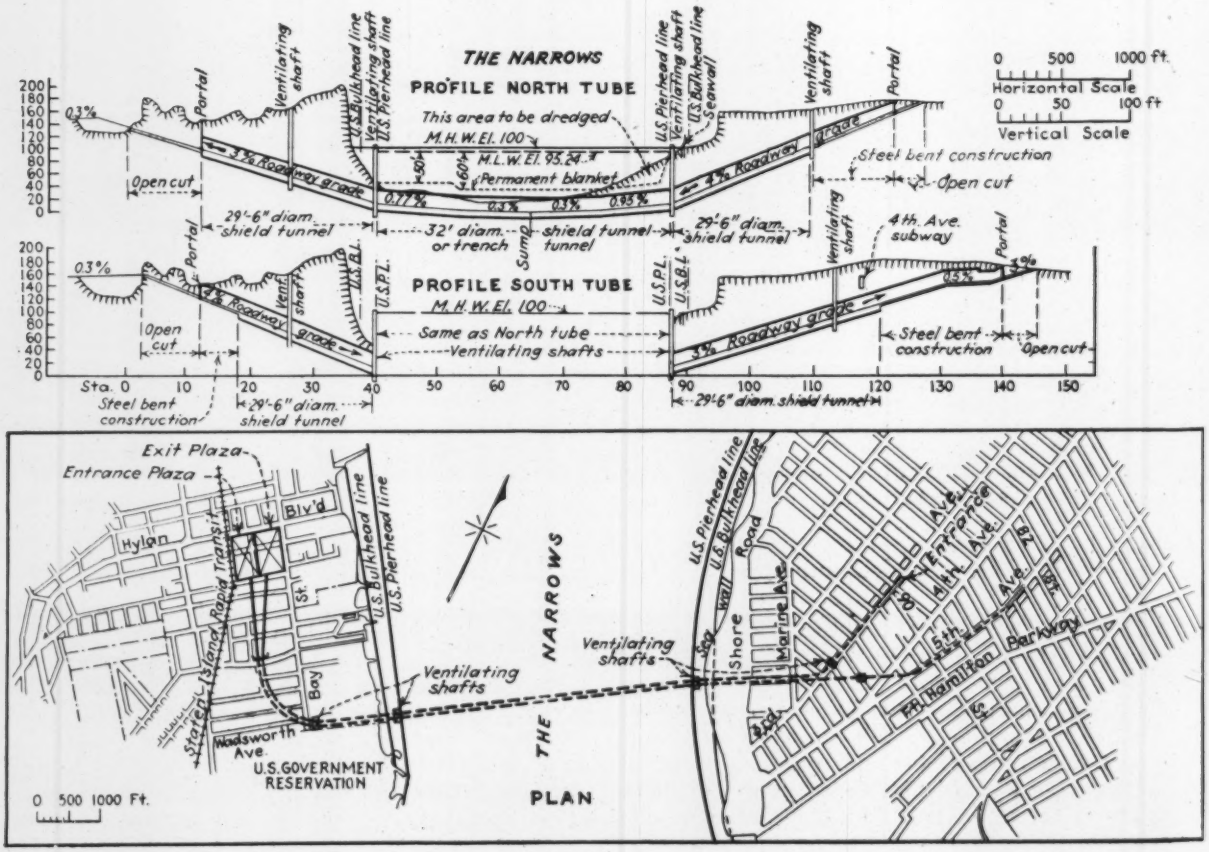
Structural Features—Preliminary plans submitted with the report provide for a twin tunnel, each tube carrying two lines of vehicles, similar in arrangement to the Holland tunnel. In the under-water section the tubes would be 31 ft. in diameter; elsewhere 29 ft. 6 in., the same as the Holland tunnel. Length between portals of the north tunnel would be 11,100 ft., and of the south tunnel 12,800 ft., with open approaches in Staten Island of about 2,000 ft. and in Brooklyn of about 500 ft. The top of the tubes would be 60 ft. below mean low water at the pier-head line, and 73 ft. below mean low water at the center of the channel. On this profile it is proposed, subject to the approval of the Secretary of War, to raise the bed of the river by depositing a permanent clay blanket on the Staten Island portion of the channel, and to dredge the Brooklyn portion so as to preserve the section area of the waterway and keep tidal flow velocity as low as possible. Each roadway would have a clear headroom of 13 ft. 6 in. and a width, for the under-bay section, of 21 ft.—1 ft. wider than that of the Holland tunnel. The size of this section is fixed by the required cross-sectional area of the air ducts for ventilation. Landward of the pier-head line the roadways would be 20 ft. wide. Maximum adverse grades are set at 3 per cent, and the maximum descending grade at 4 per cent. The report states that an estimated saving of $4,000,000 can be effected by increasing the adverse grade to 3½ per cent.

Ventilation—A method of ventiation similar to that used in the Holland tunnel is recommended, with four ventilation buildings, two at the pier-head lines and two at points about halfway between the pier-head lines and the portals. Fresh aid would be transmitted under the roadway, and vitiated air exhausted overhead.

Construction—It is recommended that in taking bids provision shall be made for the use of either the shield or trench method of construction of the under-water section. The report sets the cost of the complete tunnel, fully equipped, including shafts, ventilation buildings and equipment, paving, architectural treatment and real estate, at $77,900,000 when constructed by the shield method. It is stated that, should the trench method of construction be used for the under-water section, an estimated saving of from $5,000,000 to $9,000,000 can be effected. The time-required for construction is set at five years.

Entrances and Exits—In Brooklyn, it is planned to have entrances and exits located directly in the roadway of Third and Fifth Aves., respectively, as is shown by the plan. These two avenues would be widened to provide for the additional traffic expected. In Staten Island a large plaza would be provided, bounded by St. Johns Ave., Hylan Boulevard, Bay St., and the Staten Island Rapid Transit Railroad. All vehicles would pay toll at this point, whether bound east or west.

Although approval of the report has not yet been given by the Board of Estimate, it is expected that this will follow when certain necessary financial arrangements have been made. The project has been declared a revenue-producing enterprise, to be financed by the issue of city bonds which will eventually be amortized by the toll revenue collected.



PLAN AND PROFILE OF PROPOSED TWIN TUBES CONNECTING BROOKLYN AND STATEN ISLAND

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Folwell's Sewerage Rewritten

REVIEWED BY JOHN H. GREGORY

Consulting Engineer; Professor of Civil and Sanitary Engineering, The Johns Hopkins University, Baltimore, Md.

SEWERAGE: The Designing, Constructing and Maintaining of Sewerage Systems and Sewage Treatment Plants—By A. Prescott Folwell, Sc.D., Member, Am. Soc. C. E.; Past President Am. Soc. Mun. Imp.; Editor, *Public Works*. Tenth Edition; rewritten and reset. New York: John Wiley & Sons. Cloth; 6x9 in.; pp. 399; 121 halftones and line cuts. $5.

The first edition of this book appeared in 1898, and the tenth in 1929. The author should feel well satisfied with the accomplishment of carrying a book through ten editions and with a total issue of 28,000. The reason is that the book has been kept up to date.

Folwell's "Sewerage" is too well known to require more than brief comment on the new edition. Since the ninth edition appeared in 1922 there have been considerable and very important developments in the art of sewage treatment, and advances have been made in the design and construction of sewers. In the text the author has pointed out these developments and advances.

The book is divided into two parts: Part I, 239 pp., deals with sewerage systems and Part II, 160 pp., with sewage disposal. Part II has been entirely rewritten and in it the author has based his conclusions as to the scientific principles and importance of new developments in sewage treatment upon the opinions of recognized authorities. The reader will be especially interested to note that the very latest methods of sewage treatment and sludge digestion are mentioned and illustrated.

The book is a good one, and while not an extended treatise, is one which should appeal to the practicing engineer as well as to instructors in sanitary engineering. Advantage has been taken of the entire resetting of the book to change the typography and paragraphing. The changes are excellent ones and the new edition is much more attractive than its predecessor. The cuts and drawings are well executed and the book is well printed and bound. An 11-p. index is included. The writer regrets, however, to note that immediately following the table of contents, the list of illustrations and also the list of tables has been omitted. To the practicing engineer lists of tables and illustrations are often of great convenience.

Utilities and Their Consumers

PUBLIC UTILITY SERVICE AND DISCRIMINATION: Managerial Problems, Regulations and Practices — By Ellsworth Nichols, Associate Editor of *Public Utilities Reports*. Rochester, N. Y.: Public Utilities Reports, Inc. Cloth; 6x9 in.; pp. 1087. $10.

Earlier digests of commission rulings and court decisions issued by the publishers of this volume have dealt with valuation, depreciation and rate making. The present work is confined to relations between the utilities and their consumers, with particular reference to discrimination. The book is based largely on commission rulings, since "many problems never reach the courts, which hold that they should not interfere with the administrative functions of commissions unless an arbitrary or unlawful abuse of discretion is shown." It should be added that the relation between municipally owned utilities and consumers is also covered in the book.

The many-sided character of the volume is shown by the fact that twenty chapters are devoted to almost as many different phases of its main subject. There are several chapters on service or house connections. The first of these takes up duty to extend service, extensions and ungraded streets in advance of paving, guarantee of revenue from extension, right to require customer contribution toward extension costs, and other topics. A second general chapter is devoted to extensions for particular utilities. There are also chapters on service connections, instruments and equipment, meters and meter connections, and individual chapters on the service connections of electric, gas, water, telephone and railway utilities. A chapter on water utilities takes up water mains and pipes, conservation of water, water pressure, purity and wholesomeness of water, water for fire protection and, finally, irrigation service.

Altogether, the volume is one which should prove to be almost invaluable to those responsible for the management of any utility, whether privately or publicly owned, and to many others as well.

An Early Mechanical Engineer

MATTHEW MURRAY, PIONEER ENGINEER: Records from 1765 to 1826—Edited by E. Kilburn Scott, Assoc.M.Inst.C.E. London: Matthew Murray Memorial Fund, G. S. Wainwright, Honorary Treasurer, 5 Allerton Ave., Moortown, Leeds, England. Stiff paper; 6x9 in.; pp. 132; portraits and other illustrations. 2½s.

After being overshadowed for decades by more famous pioneers in civil and mechanical engineering, now and then a lesser but still important figure is brought prominently into view. Such is the case of Matthew Murray, the recent centenary of whose death was made the occasion of public ceremonies in Leeds, his adopted home and the scene of most of his adult life. To that city he tramped 60 miles in 1760 with his kit of tools on his back after having worked as a journeyman mechanic in Stockton-on-Tees. In 1795, a year before the opening of the famous Boulton & Watts Foundry, Murray began a partnership in what became the firm of Fenton, Murray & Wood, foundrymen and machine builders at Leeds. Here Murray, who had previously made improvements in flax-working machinery, took charge of the engine department and played no small part in the evolution of the steam engine and its application to mills and factories, railways and steamboats. James Watt, Jr., did the Murray firm the honor of spending some days in Leeds and spying (vicariously) on the Murray works, as well as buying adjacent land to prevent expansion of the plant. Murray heated his new house with steam, lighted his plant with gas and took a part in building the first gas works for Leeds.

These and many other interesting facts are recorded in the small volume under notice in the form of A Centenary Appreciation, by G. F. Tyas, before the Newcomen Society; reprints of letters and extensive notes by the editor of the volume. A Chronology of Murray, and a more extensive one covering civil and mechanical engi-

neering in Great Britain down to 1875, are included; also a bibliography.

The proceeds from the sale of the volume and from a subscription fund are to be used to erect tablets to Murray on the site of his famous "Round Foundry" in Leeds, in a central position in Leeds and at the Institution of Mechanical Engineers, London; also to establish Matthew Murray prizes for students at Leeds Technical College.

Science of City Planning

Reviewed by HAROLD M. LEWIS

Executive Engineer, Regional Plan of New York and Environs, New York City

LA SCIENCE DES PLANS DE VILLES: Ses applications a la Construction, a L'Extension, a L'Hygiene et a la Beauté des Villes, Orientation solaire des Habitations—Par A. Augustin Rey, Justin Pidoux, Charles Barde. Paris: Dunod, Rue Bonaparte, 92. Lausanne: Payot & Cie, Rue de Bourg, 1. Paper: 8½x11 in.; pp. 493; 436 illustrations. 175 francs.

The three authors of this book on the science of city planning are a French housing official, a Swiss astronomer and a Swiss architect. The book started from a paper on the orientation and exposure to sunlight of dwellings, presented by the last two authors at an international housing conference in Geneva in 1906. They and M. Rey of Paris, who had long studied such problems, decided to prepare a book on city planning from the viewpoint of orientation and sunlight. It was not until 1914 that a start was made and the material was not completed until 1928. M. Pidoux died at about the date of publication.

While the subject of the original paper has been expanded to cover many other phases of city planning, the problems are all studied primarily from the viewpoint of the need of improving health by an application of the principles of sunlight. The primary elements of health are given as "air, light and exposure to the sun."

The book is in three parts. Part I presents the astronomical data necessary for the scientific orientation of dwellings; Part II then reviews the various elements of which the city is comprised; Part III takes up the proper planning of cities. The matter of orientation, however, runs through the whole volume and special emphasis is placed upon those details of city planning which bear a relation to sunlight. In a conclusion there is presented a calculation of the densities of population that could be obtained in a city constructed according to the principles established by the authors.

Although Part I fills only 26 pp. it contains a very complete series of diagrams worked out for the latitude of Paris and showing the location of the sun at any time of the year, the duration of sunlight, and the shadows cast upon building facades with different orientation. A chapter in this section is devoted to the variation in the heat received from the sun under different orientation of buildings. It is pointed out that the most sunlight is obtained on a southern exposure but the greatest heat from the sun is obtained on an approximately southwest exposure. This leads to the establishment of an *axe heliothermique*, which becomes the basis for a city plan laid out on scientific sunlight principles. For the latitude of Paris this axis deviates 19 degrees west of south. There is little variation in this deviation for any communities within the northern temperate regions. It is stated that the facades of buildings should front upon streets parallel with this axis. The available sunlight on buildings depends not only upon the width of the street, which should be a function of the latitude of the community and the height of buildings fronting on the street, but also on the angle which the street forms with the meridian. All of these should be properly co-ordinated.

Part II (309 pp.) forms the major part of the volume. This deals in considerable detail with the orientation of the main street system and the effect of grades and widths of streets upon available sunlight. A review of prominent public squares and places in the leading cities is presented and their relative advantages from an architectural, traffic and functional point of view are discussed. Parks and boulevards are only briefly touched upon. Two chapters on buildings discuss their orientation and include diagrams showing the sunlight which would penetrate the rooms under various conditions. Under the subject of building heights the shadows thrown by buildings of different heights and orientation are discussed. Land subdivision is discussed in considerable detail with particular emphasis on the proper subdivision of blocks into building lots. A chapter dealing with transport and circulation is only a general description of types of facilities, as this has little direct connection with sunlight principles; it is followed by a brief description of water supply and sewerage problems of large cities. A well illustrated chapter on the beauty of cities discusses the questions of how beauty may be obtained and how it may be preserved. The concluding chapter in Part II deals with the various sections of the city—classified on a use basis—such as business, commercial, hotel, factory, and detached residential.

Part III (128 pp.) applies sunlight principles to the planning of cities and includes theoretical layouts based upon the requirements presented in the preceding parts of the volume. Interesting examples are given for a replanning of different sections of Paris so as to obtain the advantages of sunlight without changing the main street system. This part of the book also contains a discussion of garden cities and of sub-centers, such as Hampstead, Port Sunlight and the Krupp colonies in Essen. A short chapter discusses the historical growth of cities, particularly of Geneva and Paris. The modern tendencies of centralization and decentralization are also discussed.

In the Conclusion it is pointed out that the average density of population in Paris is approximately three times that computed by sunlight principles as adapted for perfect conditions of comfort and health.

Non-Technical Highway Manual

HIGHWAY CONSTRUCTION, ADMINISTRATION AND FINANCE—By E. W. James, Chief, Division of Design, U. S. Bureau of Public Roads. Washington, D. C.: Highway Education Board. Paper; 6x9 in.; pp. 120; illustrated, mostly halftones. 50c.

The value of this series of articles now rearranged into book form comes from high technical authoritativeness combined with exposition so simple that few readers can fail to grasp the principles of modern highway development which the author discusses. Starting with the planning of a highway system, the reader is led through road design and construction practices to problems of financing, cost keeping and road use. Interest is lent to the journey by illustrations well selected to advance the teachings of the text. As a manual of highway engineering for the non-technical reader the Highway Education Board has made an excellent selection in this volume and it is hoped that its circulation can be made wide.

Fundamentals of Railway Electrification

ELECTRIFICATION OF STEAM RAILROADS — By Kent T. Healy, Assistant Professor of Transportation, Yale University. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 395; 165 line cuts and halftones. $5.

Few subjects are of more general interest in the transportation field than railway electrification. Both to the layman and to the railroad operator it is the ultimate accomplishment to be looked forward to, and yet only an insignificant amount of railroad mileage in this country has been electrified. In fact, only in Switzerland, where 62 per cent of the mileage of the country has been electrified, can it be said that railway electrification is an important factor in transportation.

The reason for this condition lies in the fact that the high cost of changing over a railroad from steam to electric traction has so far prevented its use, except where underground operation or dense suburban traffic have made its use almost imperative. The net results is that the art is still in a development stage where economies cannot be obtained through standardization and mass production of equipment. It is, as the author of this book states, about in the stage of the automobile a score of years ago, when a motor car was chiefly the plaything of the rich.

In this book the author has attempted to bring together in concise form all the factors bearing on railway electrification as it stands today for the use of those who would form a complete picture upon which to base their judgment of the advantages and operating problems of electric traction for standard-gage railways. Beginning with an analysis of the general economics of electrification, the author takes up the many details of the change from steam to electric traction, beginning with an outline of the possible sources of power, power contracts, and substations, distributing systems, and the various types of contact systems and supply structures. This is followed by a discussion of the economic operation of transmission and distribution systems, the general problems of motive power and of getting the power to the motors, the characteristics of direct-current and alternating-current traction motors, the transmission of power from the motors to the driving wheels, and the elements of the locomotive. The book closes with a discussion of organization and personnel for electric operation.

Two Municipal Year Books

THE MUNICIPAL YEAR BOOK FOR 1928—Edited by Edwin C. Fairchild London: The Municipal Journal. Cloth 6x9 in.; pp. 1132 + Index. 20s.

THE EMPIRE MUNICIPAL DIRECTORY AND YEAR BOOK, 1929-30—London: Municipal Engineering. Cloth; 6x10 in.; pp. 321 + Diary. 12½s.

These municipal annuals, one covering Great Britain and the other the British Empire, follow along their well-known lines for the most part, but the larger book contains considerable important additional material. The smaller of the two books confines its directory material to the leading administrative municipal officials of the local governing areas included. Its annual reviews of progress in municipal fields are largely of the "write up" character, supplementary to the advertising.

The British Municipal Year Book is fuller than the other one in its directory pages, giving names and street addresses of members of municipal governing bodies as well as of administrative officials and general statistics and descriptive text as to the activities of the several places listed. The annual reviews contain much valuable information as to the status of water supply, sewage treatment and a great variety of other topics. There are many statistical tables on municipal activities, together with descriptions of the various prevailing schemes of local government. There is also an analysis of the new British local government bill, which, when in effect, will go far toward revolutionizing local government and rate making (taxation). New features are considerable information regarding privately owned utilities—water, gas, electric light and tramways. Heretofore the municipal Year Book has been confined almost wholly to municipalities.

Three Volumes Brought Into One

BUILDING ESTIMATORS' DATA BOOK—By Charles F. Dingman, Architectural Engineer. First Edition. New York and London: McGraw-Hill Book Co. Bound; 4x7 in.; pp. 159; line cuts and tables. $2.50.

Engineering estimators familiar with the author's older books on Plan Reading and Quantity Surveying, Estimating Building Costs and Construction Job Management will appreciate their condensation into this single volume of small dimensions. By condensed tabulation the author gets all of the estimating data of the three older books into marvelously few pages. Many of the data are new; all are arranged to facilitate the use of calculating machines and to fit modern record-keeping systems used by contractors. Each division of work—as excavation, sheet piling and hauling, or brick and hollow tile work—is given a separate chapter. With the introduction on rules, definitions, symbols, etc., there are fourteen chapters. In their new form the author's comprehensive collection of building construction data for estimators takes on increased value.

Publications Received

DATA ON THE NAVIGABILITY of Hudson Strait is given in a report of the Hudson Strait Expedition of 1927-28, which has been printed by the Canadian Government. Copies may be obtained from the Deputy Minister of Marine, Ottawa, Ont.; 50c.

SPRAY-PAINTING is given attention in the May issue of *Labor Review* (U. S. Bureau of Labor Statistics, Washington, D. C.) under the title of "Spray Painting Practices and Hazards." A valuable section on state regulations applying to spray painting is included. In our issue of May 16, 1929, p. 802, a book entitled "Practical Railway Painting and Lacquering" was reviewed.

THE SUNLUNG FLOOD-PREVENTION PROJECT of the Board of Conservancy Works of Kwangtung, China, is the title of a 25-p. illustrated quarto pamphlet which describes "the works now completed for the protection against floods of the Sunlung Valley, West River." The report was compiled in accordance with instructions issued to Capt. N. R. Bjuke, in charge of the work, under G. W. Olivecrona, engineer in chief, whose address is Canton, China. The ninth annual report of the board for the period ended Sept. 30, 1928, has also just been issued.

MUNICIPAL ACTIVITIES of the City of Cincinnati for the year 1928 is a welcome variation from the general run of municipal reports. It serves the combined purpose of a directory of the various executive and administrative departments of the city under C. O. Sherrill, city manager, and a summary of the high spots in their activities. Diagrams and halftones are freely used. Some of the diagrams are almost useless because of direct reproduction from drawings not properly lettered for reproduction, but fortunately there are not so many of these annoyances as appear in many publications.

THE UNITED STATES CONSTRUCTION Quarterly is a new periodical under the general direction of David Lawrence, editor of "The United States Daily," which will cover the field of federal activity relating directly and indirectly to construction operations. The first issue contains some 80 pp. of articles and news stories embracing bureau organization, research work, engineering and contracting. The contents of the quarterly will be

exclusively factual statements without editorial opinion. The first issue presents a comprehensive table of contents and gives promise of a periodical which will have a distinctly useful purpose.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

BLACK HORSE OF THE SEA—By Robert D. MacMillen. New York: Merritt-Chapman & Scott Corp. Bound; 9x11 in.; pp. 39; illustrated.

A handsomely illustrated classified listing of some of the principal work done by the concern mentioned, preceded in each case with an introduction of general interest.

BLUE BOOK OF SOUTHERN PROGRESS, 1929—Baltimore: Manufacturers Record Publishing Co. Paper; 6x9 in.; pp. 322; illustrations and tables. 50c.

Contains a wide range of statistical and other information regarding the progress and status of the South, and its rapidly growing business and manufacturing interests.

BUSINESS LAW FOR ENGINEERS—By C. Frank Allen, Member, American Society of Civil Engineers, Member Massachusetts Bar, Member American Railway Engineering Association, Formerly Professor of Railroad Engineering, Massachusetts Technology. Part I—Elements of Law for Engineers. Part II—Contract Letting. Third Edition. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; $4.

A chapter on cost-plus contracts has been added to this edition, and "material changes" have been made in "two of the standard forms of contract." The first edition was noticed in *Engineering News-Record*, Nov. 15, 1917, p. 940.

CODE OF MINIMUM REQUIREMENTS FOR THE HEATING AND VENTILATION OF BUILDINGS, Adopted June, 1925. 1929 Edition—New York: American Society of Heating and Ventilating Engineers, 29 West 39th St. Flexible; 7x10 in.; illustrations and tables. $5.

EFFECT OF TEMPERATURE ON THE SETTING TIMES OF CEMENTS and on the Strength of Cements, Mortars and Concretes—By W. N. Thomas, M.A., D.Phil., A.M.Inst.C.E., and N. Davey, B.Sc., A.M.Inst.C.E. London: His Majesty's Stationery Office. Paper; 6x9 in.; pp. 38. 1s.

ELECTRIFICATION OF STEAM RAILROADS—By Kent T. Healy, Assistant Professor of Transportation, Yale University. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 395; 165 line cuts and halftones. $5.

ELEMENTARY STRUCTURAL PROBLEMS IN STEEL AND TIMBER—By C. R. Young, B.A.Sc., C.E., M.Eng.Inst. of Can., M.Am.Soc.C.E.; Professor of Structural Engineering in the University of Toronto. New York: John Wiley & Son. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. 230; 104 line cuts. $3.50.

FACTS AND FIGURES OF THE AUTOMOBILE INDUSTRY—1929 Edition. New York, Detroit, Washington, D. C., and Paris: National Automobile Chamber of Commerce. Paper; 6x9 in.; illustrated.

FIELD ENGINEERING: A Handbook of the Theory and Practice of Railway Surveying, Location and Construction—By William H. Searles, C.E., Late Member American Society of Civil Engineers. Twentieth Edition, revised and enlarged by Howard Chapin Ives, C.E., Civil and Consulting Engineer. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Flexible binding; 4x7 in. Two volumes in one: I, Text, pp. 342, with 153 diagrams; II, Tables, pp. 386. $4. Can be bought separately, at $2.50 a volume.

A chapter on Highway curves has been added to Vol. I of this edition and "many changes and additions" appear in the tables constituting Vol. II. Chief of these are seven-place instead of five-place tables, to meet the increasing use of calculating machines, and a rearrangement of the table entitled Trigonometric Formulas.

FINANCIAL STATISTICS OF STATES, 1927—Paper; 6x9 in.; pp. 125. 20c. from United States Government Printing Office, Washington, D. C.

GOVERNMENTAL PURCHASING—Russel Forbes, Secretary, National Municipal League; Secretary, Governmental Research Association; Director, Municipal Administration Service; and Lecturer on Municipal Government, New York University. New York and London: Harper & Bros. Cloth; 6x9 in.; pp. 370; 80 line cuts. $5.

DIE GRUNDBAUTECHNIK UND IHRE MASCHINELLEN HILFSMITTEL—Von Dipl.-Ing. G. Hetzell, Baurat, Hamburg, und Dipl.-Ing. O. Wundram, Oberbaurat, Hamburg. Berlin: Julius Springer. Bound; 7x10 in.; pp. 399; 436 illustrations. 35 marks.

THE IDEALS OF ENGINEERING ARCHITECTURE—By Charles Evan Fowler, M.Am.Soc.C.E., M.Eng.Inst. of Canada, M.Soc. Terminal E, Chicago: Gillette Publishing Co. London: E. & F. N. Spoon. Bound; 6x9 in.; pp. 295+Index. $4.

INDUSTRIAL FUEL AND POWER STATISTICS FOR ONTARIO; Calendar Year 1925—By E. S. Malloch and C. E. Baltzer. Compiled and published with the approval and co-operation of the Dominion Fuel Board and the Dominion Bureau of Statistics. Ottawa, Ont.: Department of Mines. Papers; 6x9 in.; pp. 23, maps. 10c.

Among other statistics contains table of number of power establishments by districts, with summary of equipment.

INTRODUCTION TO AGRICULTURAL ECONOMICS—By Fred R. Yoder, Ph.D., Professor of Rural Social Science, State College of Washington. New York: Thomas Y. Crowell Co., Cloth; 5½x8 in.; pp. 472; illustrations and tables. $3.

A readable comprehensive survey for agricultural students and the general reader. Chiefly a compilation from earlier writers. No apparent attempt to bring statistics to date; those comparing urban and rural death rates stop with 1916.

KENNETT RESERVOIR DEVELOPMENT: An Analysis of Methods and Extent of Financing by Electric Power Revenue—By Lester S. Ready, Consulting Engineer. Bulletin No. 29. Sacramento: California Department of Public Works. Paper; 6x9 in.; pp. 65; illustrations and folding maps.

LIGHTNING, CODE FOR PROTECTION AGAINST—Washington, D. C.: U. S. Bureau of Standards. Paper; 5x7; pp. 114. 25c.

LIST OF WATER POWERS IN THE PROVINCE OF QUEBEC—Co-operatively prepared by the Dominion Water Power and Reclamation Service, Department of the Interior, Ottawa, the Quebec Streams Commission and the Hydraulic Service Department of Lands and Forests, Quebec. Paper; 7x10 in.; pp. 139.

THE NEW INTERNATIONAL YEAR BOOK: A Compendium of the World's Progress for the Year 1928—Edited by Herbert Treadwell Wade. New York: Dodd, Mead & Co. Cloth; 7x10 in.; pp. 835; illustrations and maps. $6.75, cloth; $7.75, red buckram; $9.50, half leather; $12.50, full leather.

Contributors on engineering subjects include: Civil Engineering, James K. Finch, Professor of Civil Engineering, Columbia University; Electrical Engineering, Walter I. Slichter, Professor of Electrical Engineering, Columbia University; Metallurgy, Edward Hodges Robie, Associate Editor of *Engineering & Mining Journal*; Power Engineering; Power Plants, etc., Alfred D. Blake, Associate Editor of *Power*; Railways, William E. Hooper, former Financial Editor, *Railway Age*; and Sanitary Engineering and Municipal Subjects, M. N. Baker, Associate Editor, *Engineering News-Record*.

PHYSICAL AND MECHANICAL PROPERTIES OF PORTLAND CEMENTS AND CONCRETES: A Report of Several Investigations Conducted by the Engineering Experiment Station, Purdue University, in Co-operation With the United States Bureau of Public Roads—By W. K. Hatt, Head, School of Civil Engineering, Director, Laboratory for Testing Materials, and R. E. Mills, Research Assistant, Engineering Experiment Station. Lafayette, Ind.: Purdue University. Paper; 6x9 in.; pp. 99; 44 illustrations.

QUALITY OF WATER OF THE COLORADO RIVER IN 1926-1928—By C. S. Howard. Water Supply Paper 636-A. Contributions to the hydrology of the United States, 1929. Washington, D. C.: U. S. Geological Survey. Paper; 6x9 in.; pp. 14; illustrated.

RAILROAD CONSOLIDATION: A Series of Addresses and papers presented at the semi-annual meeting of the Academy of Political Science, April 24, 1929—Edited by Parker Thomas Moon. New York: The Academy of Political Science, Columbia University. Paper; 6x9 in.; pp. 125. $2.50.

RECENT ECONOMIC CHANGES IN THE UNITED STATES: Report of the Committee on Recent Economic Changes of the President's Conference on Unemployment. Herbert Hoover, Chairman, Edward Eyre Hunt, Secretary. Paper; 6x9 in.; pp. 32. 5c. from Superintendent Public Documents, Washington, D. C.

Abstracted in *Engineering News-Record*, May 23, 1929, p. 842. The full report is published by the McGraw-Hill Book Co.

RESEARCHES ON SPRINGS: Static and Endurance Tests of Laminated Springs Made of Carbon and Alloy Steels—By R. G. Batson, A.K.C., M.Inst.C.E., M.I.Mech.E., and J. Bradley, B.A., B.A.I. (of the National Physical Laboratory). London: His Majesty's Stationery Office. Paper; 6x9 in.; pp. 33; 11 line cuts. 1s.

ROLLING TESTS OF PLATES—By Wilbur M. Wilson, Research Professor of Structural Engineering. Urbana, Ill.: Engineering Experiment Station, University of Illinois. Paper; 6x9 in.; pp. 60; 33 illustrations.

SHIPWAYS TO THE SEA: Our Inland and Coastal Waterways—By Ernest S. Clowes. Baltimore: The Williams & Wilkins Co. Cloth; 6x9 in.; pp. 196; illustrated. $4.50.

STRENGTH OF MATERIALS—By Arthur Morley, D.Sc., M.I. Mech.E., formerly Professor of Mechanical Engineering in University College, Nottingham. Seventh Edition. New York, Toronto & London: Longmans Green & Co. Cloth; 6x9 in.; pp. 569; 267 diagrams and numerous examples. $4.20.

Of the 201 "articles" in the present edition ten have been rewritten. The book is designed "mainly for engineering students," presumably in British schools.

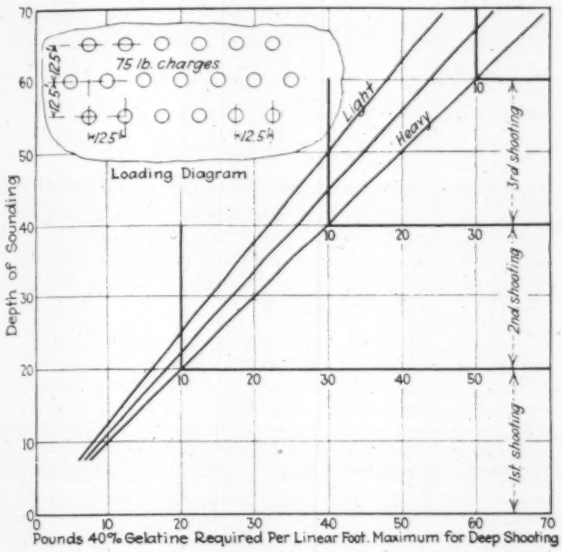
STRESSES STATICALLY DETERMINED—By John Clayton Tracy, C.E., M.Am.Soc.C.E., Professor of Civil Engineering, Sheffield Scientific School of Yale University. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 8x11 in.; pp. 462; 445 illustrations. $6.

A STUDY OF GROUNDWATER IN THE POMPERAUG BASIN, CONNECTICUT, With Special Reference to Intake and Discharge—By Oscar Edward Meinzer and Norah Dowell Stearns. Prepared in co-operation with the Connecticut State Geological and Natural History Survey. Contributions to the hydrology of the United States, 1928. Water-Supply Paper 597-B, U. S. Geological Survey. Paper; 6x9 in.; pp. 146; illustrations, folding maps and tables. 35c. from Superintendent of Public Documents, Washington, D. C.

Letters to the Editor

Blasting to Settle Fills in Muskeg

Sir—In my article entitled "Blasting Settles Road Fills in Muskeg" which appeared in the *Engineering News-Record* May 16, 1929, I find that several typographical errors appeared in the drawings on p. 789. In Fig. 16 appearing on this page the figures at the bottom of this illustration representing the pounds per linear foot of the amount of 40 per cent gelatin dynamite required for all stages of deep shooting should read, from left to right, 0, 10, 20, 30, 40, 50, 60, 70, instead of 0, 100, 200, etc. In this same illustration the distances between holes shown in the loading diagram should be 12.5 ft., in both directions instead of 125 ft., as shown. In Fig. 17 the figures across the bottom of the illustration representing pounds per linear foot used in the first deep shooting should read 0, 10, 20, 30 and 40 instead of 0, 100, 200, etc.



DYNAMITE REQUIRED FOR DEEP SHOOTING

Quantities given by this graph are considered maximum. They are to be tempered by the experience of the engineer. As a further guide to the estimate of quantities, 10 to 12 lb. per linear foot for 20 ft. soundings will usually suffice for light work. In addition the factor of 2.65 lb. per foot of blast hole can be used as a check. This factor, 2.65, was obtained from 1928 experience where 69,071 lb. of explosives was used to 26,084 lin.ft. of blast hole.

Since writing the article I have made up a new graph giving the pounds of 40 per cent gelatin dynamite required per linear foot, maximum for deep shooting, which I am using this season. The graph is shown in the accompanying illustration.

P. W. RIEDESEL.

Wazata, Minn.
May 21, 1929.

Poor Aggregates Affect Durability of Concrete

Sir—The series of articles "Basic Principles of Concrete Making," by F. R. McMillan, are interesting and instructive. Referring to the one which appeared in your issue of May 2, the writer feels that greater weight should be given to the effect of the quality of the aggregate upon the durability of the concrete.

There are a great many concrete structures in various parts of the U. S. which have begun to disintegrate badly within a few years after they were completed, although when new the quality of the concrete seemed excellent. In every such instance that has come under his observation, the writer has found that the concrete was made either with dirty aggregates or with a variety of coarse aggregate which would disintegrate readily when exposed to the weather. He has found just as bad cases of disintegration in southern climates as in the far north.

Long experience makes one hesitate to accept unreservedly the claims that are made for the water-cement ratio as more or less of a cure-all for concrete troubles. Accurate control of the quantity of water in the concrete mix is unquestionably very important, but there are so many other factors which vitally affect the strength and durability of concrete that it seems unfortunate that the water-cement ratio has been allowed to occupy the spot-light position alone and so continuously.

WALTER H. WHEELER.

Minneapolis, Minn.,
May 23, 1929.

Designing Concrete Pavement for Airports

Sir—I note in my paper "Designing Concrete Pavement for Airports" in your issue of May 23 that an error crept into the table. The recommended edge thickness for concrete runway pavement under a total wheel load of 7,500 lb. should, of course, be 8.5 in., the same as recommended for taxiway pavements carrying the same wheel load. Some comment may be received on the apparent discrepancy.

E. F. SMITH.
Assistant Manager,
Highways and Municipal Bureau.

Chicago, Ill.
May 29, 1929.

No Such Thing as Crystallization of Pipe or Other Metals

Sir—The statement about crystallization of cast-iron pipe at the top of col. 1, p. 842, *Engineering News-Record*, Dec. 6, 1928, is unfortunate. Metals do not crystallize under stress or impact. Extensive citations in support of this statement may be found in Letter Circular 204, U. S. Bureau of Standards, Washington, D. C., dated July 14, 1926, copies of which may doubtless be had on application.

H. L. WHITTEMORE,
Mechanical Engineer,
U. S. Bureau of Standards.

Washington, D. C.

The statement as to crystallization to which Mr. Whittemore objects was made rather incidentally by C. L. Ehrhart, superintendent of water-works, Council Bluffs, Iowa, in the course of an A.W.W.A. paper on the construction of a distribution system, at a point in the paper where referring to cutting cast-iron pipe to the desired length just before laying it in the trench.—EDITOR.

An Interpretation of the O'Fallon Decision

Sir—The Supreme Court decision in the O'Fallon case is more important, I believe, than is indicated in the editorial on p. 813 of your May 23 issue.

The decision requires cost of reproduction to be found and considered on the basis of costs current as of the date of valuation, which the commission declined to do. In all of its valuations, including the O'Fallon Railway, the commission has given dominating weight to its estimates of cost of reproduction. If the commission respects these precedents of its own, the decision of the court is most important.

In the end, the commission will be required to assign fair weight to the cost of reproduction, which is a definite measure of the amount of money which must be invested, or which the owners are entitled to have invested, in a railway plant as of the date of valuation.

J. L. CAMPBELL.

San Francisco, Calif.,
May 28, 1929.

Possibly Mr. Campbell is correct in saying that "in the end, the commission will be required to assign fair weight to the cost of reproduction," but the end appears to be brought no nearer by the present decision. The Supreme Court definitely states that the question of the weight which is to be assigned to reproduction values is not before it. Also, it states that "there are some, perhaps many, railroads the ultimate value of which should be placed far below the sum necessary for reproduction."—EDITOR.

News of the Week

Chicago River Again Reverses

Reversal of flow in the Chicago River occurred again on June 11, owing to a sharp lowering of the lake level. Instead of the usual flow of comparatively clear water from the lake, the main stem of the river had a turbulent lakeward current of the ink-black water that is characteristic of the north branch and which normally goes down the south branch to the drainage canal. The regulating gates of this canal, at Lockport, were opened to increase the flow and again start a current inward from the lake. High winds are reported to have caused the sudden drop in lake level, but heavy rain in the Chicago area may have been a factor in the reversed flow. A similar reversal in April was noted in *Engineering News-Record* of May 2, 1929, p. 719.

Lackawanna to Purchase Power for Electrification

Electric power for the operation of the suburban trains of the Delaware, Lackawanna & Western Railroad will be purchased from public service companies in the territory through which the line runs, according to a decision announced June 6. This means the abandonment of the contemplated plan to build power plants to serve the 173 miles of track to be electrified. Direct current will be used at 3,000 volts, distributed through overhead contact wires.

Bids will be called for by the railroad in the near future for the construction of 141 new all-steel coaches with motor equipment and the reconstruction of 141 of the present steel coaches, which will be used as trailers. This will be followed by requests for bids for the structural steel work for the necessary overhead bridges and for five substations to be located at Bergen Junction, Newark, Summit, Bernardsville and Denville, N. J.

Three Hundred Men On Subway Work in New York Dismissed

Board of Transportation States That Labor Agitations Reduced Efficiency of Men

ENGINEERS of the third grade to the number of about 300 have been laid off without notice by the New York City Board of Transportation as the result, according to officials, of a necessary reduction in force. Many of the engineers involved have, as members of the Union of Technical Men, been agitating for a raise in pay which was approved some time ago by the city Board of Estimate, but which has not yet been put into effect by the Board of Transportation. Several demonstrations have been staged, including mass visits to the mayor, the Board of Estimate and the chairman of the Board of Transportation and a one-day strike of protest. Names of those to be discharged, who are all in a classification known as grade C, were taken from the bottom of the Civil Service rating lists.

The Board of Transportation, in its official statement said that it was "impelled to take this action because the quality of the work of the third grade employees had been impaired by the affiliation of a large number of them with an outside organization which has conducted a turbulent agitation under the leadership of men not employed by the city. This group has been seeking promotion from third grade to fourth grade without promotion examinations and the board refused to permit any employee to enter a higher grade without examination to determine his qualifications."

The statement that the men affected were seeking promotion to a higher grade is denied by them. They claim that all they sought was an increase in their minimum pay from $2,600 to $3,120, an increase approved by the Board of Estimate and in effect in other departments.

At a meeting of the Union of Technical Men held on Tuesday evening plans for a general strike of engineers in the employ of the Board of Transportation were discussed but no definite action taken. About 1,000 men would be effected.

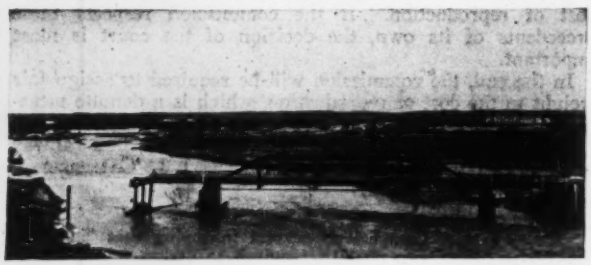
New Susquehanna Bridge Started

Work has been started upon a new concrete bridge across the Susquehanna River connecting Columbia and Wrightsville, Pa. This will have a length, including approaches, of 7,400 ft. The river section, 5,532 ft. long, will consist of 28 arches. The bridge will accommodate four lanes of traffic and will replace a combined railway-highway bridge, which is now closed to vehicles except at intervals between trains. The new structure will be financed by the counties of Lancaster and York, and a nominal toll will be charged until the cost of $2,500,000 is paid off.

St. Louis Opens Howard Bend Waterworks Plant

The new $12,000,000 pumping and water purification plant on the Missouri River at Howard Bend has been officially opened by the city of St. Louis. Features of the new plant include a shore intake, boilers and low and high service pumps, works for sedimentation, coagulation, softening, filtration, chlorination and carbon dioxide treatment; a steel force main; and a large distribution reservoir. Although the plant is designed for an ultimate capacity of 200 m.g.d., only 55 m.g.d. is provided for at present.

CLOUDBURST CAUSES FLOOD IN CHEYENNE, WYO.



Heavy storms reaching cloudburst proportions on June 1 caused damage estimated at several hundred thousand dollars in the vicinity of Cheyenne, Wyo. Although several small streams were affected, most of the damage was caused by Crow Creek, which flows through the city. State highway bridges suffered slight injuries, and a number of county bridges and approaches were destroyed or seriously damaged, as is pictured above. Two earth dams on a ranch below the city, impounding approximately 1,800 acre.-ft. of water, were washed out. The flood also destroyed several miles of track and at least one bridge of the Colorado & Southern Railroad. Only one death was reported, that of an aged Mexican woman who was drowned in her home in Cheyenne.

Louisiana Chooses New Head for Highway Department

W. H. Norckauer, formerly office engineer of the Louisiana State Highway Department, has been appointed state highway engineer by Governor Long. He succeeds L. R. Ames, who resigned on account of political interference with the department, as noted June 6, 1929, p. 919. Mr. Norckauer is the fourth man to hold this post during the past year, being preceded by Mr. Ames, Max Cunningham, now maintenance engineer of the department, and James M. Fourmy. He is the oldest engineer in the department in point of service, having been employed in various capacities in state road work for the past twenty years.

Another Injunction Sought to Halt Floodway Construction

Suit was instituted in the U. S. District Court at St. Louis, Mo., June 13 by George W. Kirk, the owner of land valued at $7,500 in New Madrid County, Mo., seeking an injunction against the federal government, Secretary of War Good, Major-Gen. Edgar Jardwin and the Mississippi River Commission forbidding any or all of the defendants from awarding contracts for the construction of the proposed New Madrid-Bird's Point spillway on the grounds that plans for the spillway call for the confiscation of lands without due process of law or just compensation. Mr. Kirk contends that he has received no reasonable offer for his property, nor has any condemnation proceeding been instituted, yet he is unable to borrow money on the land, sell it or interest anyone in operating it.

The suit is similiar to one brought several weeks ago by another landowner in the district. As noted in *Engineering News-Record*, May 30, 1929, p. 883, application for an injunction on these grounds was denied by Federal Judge Charles B. Davis.

File Applications to Build Two Texas Rail Lines

Permission to build two new lines of railroad in Texas is being sought of the Interstate Commerce Commission. The first application has been made by the Fort Worth & Denver Northern Railway Company, Fort Worth, Tex., for authority to construct a new line from Childress to Pampa, Texas, 110 miles in length. Funds for the proposed extension would be furnished by the Colorado & Southern, which now owns all the stock of the applicant.

The second application has been filed by the Gulf & West Texas Railway Company, San Antonio, Tex., for authority to construct a new line from Fredericksburg, Gillespie County, to Brady, McCullough County, Texas, a distance of approximately 113 miles or, by an alternate route, 170 miles. The plan of financing proposed involves the issue of capital stock and bonds to be sold to the public and guaranteed as to principal and interest.

Hoover Names Canal Board

Acting under the recent Congressional resolution, the President has approved the following board to make the new survey of the Nicaraguan Canal and other possible locations for an interoceanic waterway: Major-Gen. Edgar Jadwin, chairman; Major Ernest Graves; Sidney B. Williamson; Anson Marston; and Frank M. Williams. While the announcement of the personnel of the commission was made at the White House, it is understood that the President designated General Jadwin, the chief of engineers, as chairman of board and that it was he who put forward the other names.

Census Bill Passed

Congress on June 13 gave final approval to the census and reapportionment bill providing for the fifteenth and subsequent decennial censuses and the automatic reapportionment of Congress according to those censuses. The date for the next enumeration was set at April 1, 1930. This means that the interval between the censuses of 1920 and 1930 will be ten years and three months, as the count of 1920 was taken Jan. 1. The first four censuses (1790-1820) were taken on the first Monday in August of the respective years. Following that, the date June 1 was selected, which held for the next eight censuses, including that of 1900. In 1910 the date was changed to April 15 and in 1920 to Jan. 1.

The suggestion to have all enumerators selected under Civil Service rules was rejected by Congress, which provided that Civil Service classification should apply only to the special agents employed by the Census Bureau to check the work of enumerators and supervisors taking the count.

Subjects to be covered in the census include: Population, agriculture, irrigation, drainage, mining, manufactures and the distribution of goods; the latter a new feature. The census of manufactures is to be taken in 1929 and repeated at 2-year intervals. An additional census of agriculture is specified for 1935.

Cost of Waterway Bridges Not to Be Charged to Illinois Roads

An attempt to secure additional funds for the completion of the Illinois waterway by charging to the state road fund the cost of all highway bridges crossing it has been declared illegal by the attorney general of the state. As noted in *Engineering News-Record*, May 30, 1929, p. 884, about $5,000,000 is needed to complete the project, and a new bond issue cannot be submitted to a vote for about two years. The attorney general's decision is the result of a suggestion that highway bridges over the canal be charged to the road fund, thus releasing money for other canal purposes.

Turner to Resign as N. Y. City Transit Consultant

Daniel L. Turner, consulting engineer to the New York Transit Commission and the Board of Transportation, will retire from public service Sept. 1. After a vacation Mr. Turner plans to resume private engineering practice.

Mr. Turner received his engineering training at Rensselaer Polytechnic Institute. He became an instructor at the Lawrence Scientific School of Harvard University, leaving there in 1900 to become an aide of the Board of Rapid Transit Railroad Commissioners. In this position he aided in the design of the first New York subway lines, and conducted surveys for Brooklyn extensions. Later he became associated with a number of municipal agencies in the transportation field. In 1918 he became chief engineer of the Public Service Commission and in 1921 consulting engineer of the Transit Commission. When the Board of Transportation was organized in 1924 he was designated as consulting engineer for this body also.

Besides these activities in New York City, Mr. Turner has acted as a consultant in the preparation of plans for the joint vehicular and rapid transit highway in Detroit, has been consulting engineer for the Pittsburgh Transit Commission and the North Jersey Transit Commission, and since 1924 has headed the Suburban Transit Engineering Board of the Port of New York Authority.

Program for Am. Soc. C. E. Meeting at Milwaukee

At the annual convention of the American Society of Civil Engineers, at Milwaukee, Wis., July 9-12, the first day will be for a meeting of representatives of the local sections. The formal opening will be on July 10, when Anson Marston will deliver the annual presidential address. For the afternoon session the following papers are listed: "Relation Between Rail and Waterway Transportation," by E. A. Hadley, chief engineer, Missouri Pacific Railroad; "Waterway Transport with Reference to Operation," Major-Gen. T. Q. Ashburn; Waterway Transport with Reference to Terminal," Major Rufus W. Putnam. A dinner will be given, followed by a lecture by Dr. S. A. Barrett, director of the Milwaukee Public Museum, on "Tamest Africa," describing a recent expedition.

Technical sessions will occupy morning and afternoon of July 11. The city planning division has the following papers: "County and Regional Planning," by E. A. Howard, engineer of the Milwaukee regional planning department; "The City Plan of Kenosha, Wis.," by Wm. O'Brien, city manager; and "Legal Problems in Set-Back Lines," by Clifton Williams, assistant city attorney of Milwaukee. The highway division has two subjects: "Equitable Distribution of Vehicle License

Fees and Gasoline Taxes," by George B. Sowers, division of engineering, Cleveland, Ohio, and Professor H. R. Trumbower, University of Wisconsin. The waterways division will have papers on "The Welland Ship Canal," and "The Illinois Waterway," while the construction division will have only committee reports, except that at a joint meeting with the waterways division there will be two papers: "Construction Methods on the Welland Ship Canal," by E. G. Cameron, and "Construction Methods on the Ohio, Mississippi, and Missouri Rivers," by F. E. Lamphere. An outing on Lake Michigan is provided for July 12.

Lay Cornerstone for Department of Commerce Building

Formal laying of the cornerstone for the new Department of Commerce Building in Washington, D. C., was held June 10, with President Hoover delivering the principal address. This will be the largest of the new federal buildings in the development of the Pennsylvania Ave. triangle, and will contain about 1,092,000 sq.ft. of floor space. It will occupy three city squares, extending from D to E St., and from Fourteenth to Fifteenth St., and will cost approximately $17,500,000. Dimensions are: length, 1,050 ft.; width, 325 ft. The land area occupied is about 345,000 sq.ft., nearly eight acres. The building will contain seven stories, including a complete basement for general use and a sub-basement for heating and power plant. It will provide quarters for all activities of the department in Washington, with the exception of the Bureau of Standards, which is housed in its own specially constructed building in the suburbs.

Arizona Grants Pay Increases to 20 in Highway Dept.

Salary increases ranging from $200 to $1,200 per year have been granted to twenty department heads, engineers and technical men of the Arizona State Highway Commission, effective July 1. The increases total $17,100. As the annual payroll of the Highway Department, including the Motor Vehicle Division, now approximates $1,325,000 annually, the present increase represents 0.125 per cent of the total salaries.

Pan-American Highway Delegates Named by President

Official representatives of the United States at the Pan-American Congress of Highways to be held at Rio de Janeiro, Brazil, August 16-31, were named June 17 by President Hoover. The following were selected: Chairman, J. Walter Drake, director of the National Automobile Chamber of Commerce and member of the executive committee of the Pan-American Conference for Highway Education; Senator Tasker L. Oddie, member of the Senate Committee on Post Offices and Post Roads; Congressman Cyrenus Cole, author of the Cole resolution appropriating $50,000 for a survey of the Pan-American highway; Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads and chairman of the Highway Education Board; Frank T. Sheets, chief highway engineer of Illinois and former president of the American Association of State Highway Officials; Charles M. Babcock, Minnesota Commissioner of Highways and former president of the American Association of State Highway Officials; H. H. Rice, member of the Highway Education Board and treasurer of the National Automobile Chamber of Commerce; Frederick A. Reimer, president of the American Road Builders Association.

PROGRESS ON RIVER SHANNON HYDROELECTRIC PROJECT

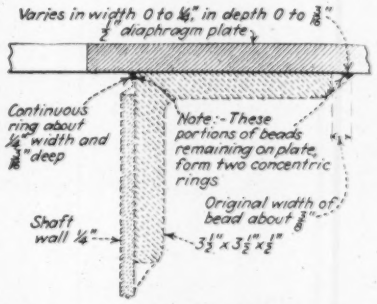
World Wide Photo

This recent view of construction on the River Shannon hydroelectric project shows a section of the dam and power house, including three penstocks. Construction cost at this stage amounts to about $18,000,000.

Failure of Welded Joint on Hackensack Bridge Airlock

Further facts of the failure of the central airlock on the Hackensack River bridge caisson on May 29, reported in *Engineering News-Record* June 6, 1929, p. 919, are as follows:

As previously described, the break occurred at a welded joint between the upper flange of the 48-in. shaft and the ½-in. bottom diaphragm plate of the 54-in. cylindrical airlock, along the plane of


Varies in width 0 to 1/16" in depth 0 to 3/16"
1/2" diaphragm plate
Continuous ring about 1/4" width and 3/16" deep
Note:-These portions of beads remaining on plate, form two concentric rings
Original width of bead about 3/8"
Shaft wall 1/4"
3 1/2" x 3 1/2" x 1/2"

SKETCH OF SECTION THROUGH CONNECTION ANGLE AND DIAPHRAGM PLATE.
Bead remnants on plate shown in black.

the plate. This diaphragm plate, an eccentric wing-shaped plate 5¼ in. wide at the narrowest point, 8¼ in. wide at the opposite point and about 14 in. wide at the sides, formed the bottom of the lock chamber. Connection between the shaft and the diapragm was made by a 3½x3½x½-in. ring angle which was electrically welded both to the outside of the shaft wall and the under side of the diaphragm plate. The plate itself was field-bolted along its outer edge to an angle at the bottom of the airlock. Because the center of the shaft was by design 1½ in. off the center of the lock, the outstanding leg of the angle at the top of the shaft was cut down to a minimum of 2 in. for about a third of the circumference of the ring to clear the line of bolt heads fastening the plate to the lock chamber. However, this feature apparently had nothing to do with the cause of the accident.

A personal examination of the lock, diaphragm plate and shaft section involved in the accident reveals the condition as shown in the accompanying illustration. Remnants of the two welding beads made at the heel and toe of the outstanding leg of the angle remained on the plate in concentric circles. At the outer ring the part of the toe bead remaining on the plate is only the extreme outer edge of the bead, varying in width from almost nothing to ¼ in. and in depth from almost nothing to 1/16 in. This remaining portion of the bead is not continuous, but for 21 distinct gaps ranging in length from ¼ in. to 3 in. it is missing entirely. The surface of the plate immediately behind

the remnant bead, where the major portion of the bead was in contact with the plate, is clean and undisturbed, indicating that there was practically no bond here between weld metal and plate. The part of the bead remaining on the toe of the angle varies in width from $\frac{1}{16}$ in. to $\frac{3}{8}$ in. (along the plane of the face of the outstanding leg) and is practically uniformly $\frac{1}{16}$ in. in depth. The surface of this bead which was in contact with the plate is a smooth plane, further indicating the lack of bond between the plate and weld metal.

The ring on the diaphragm plate formed by the remnant of the heel bead is continuous, about $\frac{1}{4}$ in. wide and $\frac{1}{16}$ in. deep, except for one stretch about 8 in. long, where the bead is almost negligible. Comparison of this portion of the heel bead with the portion remaining on the angle shows that the break occurred in the weld metal, as the remnant bead on the angle is only $\frac{1}{16}$ in. wide on the average, and about $\frac{1}{8}$ in. deep.

Although investigations have been under way since the accident, no official explanation has yet been made as to its cause.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Water and Power Receiving Much Attention — Consider Problems of the Contractor

IT IS NOT within the authority of the Federal Power Commission to reject an application for power development on the ground that it may mar scenic beauty, in the opinion of the chief counsel of the Federal Power Commission. In this opinion the solicitors of the Departments of War, Interior and Agriculture concur. The opinion has been laid before the three secretaries forming the commission and probably will be considered at their next meeting.

The question was raised in connection with the application for license of the Cumberland Hydroelectric Power Company covering a project at Cumberland Falls, Ky. This development was opposed on the ground of alleged injury to the scenic features of the falls. The Corps of Engineers and the staff of the Federal Power Commission have recommended the granting of the license. They take the view that scenic beauty will not be impaired and call attention to the fact that the power company will build the necessary roads to make the falls available to a larger number of persons. Less than 1,000 persons visit the site annually under present conditions.

The chief counsel says that the provision of the law that a project "shall be best adapted to a comprehensive scheme of improvement and utilization for the purposes of navigation, of water power development and of other beneficial public uses" was intended only to secure a comprehensive plan whereby all such uses may be effected. While the commission may issue the license with conditions for the preservation of scenic attractions, they must be in harmony with the plan of power development.

Plan Columbia River Hydroelectric Plant

The Washington Electric Company, of Seattle, has applied to the Federal Power Commission for a license covering a proposed development on the Columbia River. This application for license reaches the commission before action has been taken on the application for preliminary permit. This indicates that the applicant has completed the engineering studies and is in a position to present the detailed figures for the consideration of the application for license. The proposed project consists of two dams across the Columbia River at Rock Island, 12 miles downstream from Wenatchee. One of the dams extends from the left bank to the island and the other from the right bank to the island. The power house will be an integral part of the left bank dam. The initial installation will be 80,000 hp., but provision will be made for the installation of an additional 120,000 hp. The pool will extend upstream 20 miles and will cover 3,030 acres. The power is to be sold to the Puget Sound Power and Light Company for public utility use.

Mexican Water Rights

The International Water Commission will meet in Mexico City August 20. Important decisions are expected to grow out of this meeting. The one joint meeting of the commission and the separate meetings of the American and Mexican sections which have been held thus far, have dealt only with plans for gathering data. It is believed that all necessary information now is in hand and the full commission is in a position to discuss recommendations in connection with the international problems arising out of the use of the waters of the Colorado and the Rio Grande rivers.

Tri-State Conference Adjourns

Adjournment of the tri-state conference on the division of the lower basin waters of the Colorado River was taken June 14, without an agreement having been reached between Arizona, Nevada, and California. Although it is still believed that Arizona will seek to determine her rights through Supreme Court action, the delegates seemed in closer accord at the end of the session than ever before. The next meeting will be held on Oct. 14 in Santa Fe, N. M.

Bonnet Carre Bids Called For

Bids will be opened July 10 on the construction of the concrete weir which will control the discharge into the Bonnet Carre spillway above New Orleans, it has been announced by engineer officers in charge of the flood control program. It is estimated that 2½ years will be required to complete this work. An amount of $2,000,000 has been set aside this year to be used toward the construction of this weir, and it is planned to obtain the remaining amount necessary from next year's funds. Construction of the entire structure, including the abutments, will be covered in one contract.

A.G.C. Activities

For the purpose of bringing to the attention of government departments and to the construction industry as a whole the legal points involved when an independent contractor on a project sues for damages caused by delay, the Associated General Contractors is making a survey of court decisions. As the result of this work, several instances have been found where the courts have sustained damage claims filed by independent contractors where they have incurred losses while waiting for other independent contractors to complete their work. In one of the cases reviewed, a government bureau had elected to construct a building by awarding contracts independently to various bidders for special parts of the work. The organization that secured the job for the foundation work ran a considerable length over its allotted time. As a consequence the contractor who was to install the water tube boiler filed suit against the government for the damages that he suffered due to the delay. This damage claim was sustained by the Court of Claims.

The trend of the court decisions indicates that wherever independent contracts are let on construction work to contractors for specified parts of the work, the owner assumes the duty of co-ordinating the various operations. The A.G.C. hopes, as a result of this survey, to show that small saving can be effected by dispensing with the general contractor.

In order to curb the activities of a certain class of contractors who base their bids solely on whatever information they are able to obtain from other parties, the surety division of the A.G.C. has gone on record in opposition to the publication of unit prices either before or after an award. During a recent meeting of the division, a resolution to this effect was formally adopted after the evils of the situation had been discussed. Particular criticism was directed at what was termed "consulting contractors," during the meeting. These contractors obtain publications of unit prices, usually from surety companies and their agents, with which they are able to submit bids on work that they desire. Such organizations rarely are able to prepare sound engineering estimates on the work themselves, it was protested.

After lengthy discussion of unfair and uneconomic practices between the seller and buyer of surety contract bonds, a resolution was adopted condemning the action of any contractor who accepts a rebate on any part of the commission paid on surety bonds. It was agreed also that the payment of commissions to any individual or organization who is not engaged in the business of writing surety bonds or insurance policies should be disapproved.

Engineering Societies

CALENDAR

ANNUAL MEETINGS

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; annual meeting, Atlantic City, N. J., June 24-28.

AMERICAN WATER WORKS ASSOCIATION, New York; annual meeting, Toronto, Canada, June 24-28.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; annual convention, Milwaukee, Wis., July 10-12.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; annual meeting, Mexico City, Aug. 26-28.

THE DETROIT ENGINEERING SOCIETY, at its meeting on June 21 for a discussion of the Detroit and Canada tunnel construction will be addressed by Burnside R. Value. The name of the speaker was incorrectly given in last week's issue.

THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS annual meeting at Dallas, Tex., June 24-27, will devote much attention to the prevention and control of soil erosion. Among the many papers to be presented, a number will be of interest to civil engineers, including: "The Problem of Silt in Streams and Reservoirs in Texas," by John A. Norris, State Board of Water Engineers; "Drainage by Pumping from Wells," by W. W. Weir, University of California; "Flow of Water in Conduits," by F. C. Scobey, senior irrigation engineer, U. S. Department of Agriculture; and "Research in Land Reclamation, 1928," by R. W. Trullinger, agricultural engineer, U. S. Department of Agriculture.

THE AMERICAN INSTITUTE OF QUANTITY SURVEYORS will hold its annual convention at Detroit, Mich., June 24-26.

THE NORTHWEST SECTION, American Water Works Association, at its recent convention held in Spokane, Wash., elected the following officers: President, Ben S. Morrow, chief engineer of the Portland, Ore., Water Bureau; secretary-treasurer, Ernest C. Willard, Portland, Ore.

THE PROVIDENCE ENGINEERING SOCIETY at its annual meeting and smoker, May 28, elected William A. Kennedy president. Other officers chosen were: vice-presidents, Leighton T. Bohl, Robert K. Lyons and Fred L. Itschner; secretary, William Meyer.

THE ENGINEERS CLUB OF HAMPTON ROADS, Norfolk, Va., closed its season's program on June 8 with an outing into the Great Dismal Swamp. The U. S. Government dredge "Pullen," at work in the Dismal Swamp Canal, was visited, and the day ended with a barbecue supper at the Deep Creek lock.

THE NASHVILLE ENGINEERING ASSOCIATION has adopted the report of a committee advising the adoption of a new building code for Nashville, and will take the matter up with the mayor and city council.

Personal Notes

ROBERT GORDON SPROUL has been appointed president of the University of California at the age of 38. Mr. Sproul was vice-president and comptroller of the university, from which he was graduated with the degree of Bachelor of Civil Engineering in 1913.

A. W. KING, of the structural and technical bureau of the Portland Cement Association, has been appointed manager of the service department of the Cowham Engineering Company, Chicago, which is engaged in the construction and management of portland cement plants.

CHARLES F. GOOB, chief engineer of Baltimore, Md., has returned from a conference on airports held at Cleveland by the aviation committee of the United States Chamber of Commerce. Mr. Goob was elected a member of the committee.

PHILLIP SAUM, for the past two years connected with the Iowa State Highway Commission, has been appointed county engineer for Pottawatamie County to succeed John McGrane, deceased. His headquarters will be in Council Bluffs, Iowa.

J. X. COHEN, for more than a decade chief designing engineer of the Syracuse, N. Y., intercepting sewer board, was one in a class of five which were graduated from the Jewish Institute of Religion in New York City on May 27. Mr. Cohen was awarded the degree of Master of Hebrew Literature and Rabbi. He is a member of the Syracuse Chapter, American Society of Civil Engineers.

C. F. ABRAHAM has succeeded J. E. SCHWABB as city engineer of Alton, Ill. Mr. Schwabb will devote his time to private practice of his profession.

JAMES H. MCGRAW, chairman of the board of the McGraw-Hill Publishing Company, has been awarded the degree of Doctor of Commercial Science by New York University.

E. J. MEHREN has been appointed chairman of a committee on measures for relief of traffic congestion organized by the U. S. Department of Commerce. Mr. Mehren is a vice-president of the McGraw-Hill Publishing Company and a former editor of *Engineering News-Record*.

T. D. HOLLOWAY, recently with Charles D. Evans, consulting engineer, Shreveport, La., has been employed by the Devlin Engineering Company of Wichita, Kan., and Amarillo, Tex., and is now located at Perryton, Tex., as resident engineer on street paving.

Obituary

PETER ELBERT NOSTRAND, retired consulting engineer, died of cancer in Baltimore in his 74th year. After attending Brooklyn College and Polytechnic Institute he became, in 1875, principal assistant engineer for the Brooklyn Elevated Railway Company, retaining this position for five years, during which period he was also associated with John L. Nostrand & Son, city engineers and surveyors of Brooklyn. In 1880 he became superintending engineer on the Cape Cod Ship Canal, and in 1881 entered consulting practice in the fields of civil and mining engineering. From 1886 to 1890 and again from 1891 to 1894 Mr. Nostrand was associated with the Ramapo Water Company, first as principal assistant engineer and later as chief engineer. During the later part of this period he was also chief engineer for J. D. & T. E. Crimmins, contractors. Following this, Mr. Nostrand was for a short time, civil engineer and city surveyor for New York City and then resumed his consulting practice, being employed by the city of New York on condemnation work on the Ashokan Reservoir and by New York state on condemnation work for the Barge Canal. In 1914 he was appointed county engineer of Highways for Suffolk County, N. Y.

LOUIS HYDE EVANS, formerly division engineer and engineer of track elevation on the Chicago & Northwestern Railway but retired from active practice for some years past, died June 4 at his country home at Mast Hope, Pa. Mr. Evans was born Dec. 21, 1851, at Kenosha, Wis., and graduated from the University of Michigan in 1874 as a civil and mining engineer. He was an assistant engineer on the Erie Railroad for 1½ years, engaged on the double-tracking of the Delaware division, 1877-78. A few years later he went to the Chicago & Northwestern Railway and was engaged on location and construction work as assistant engineer for four years and division engineer for nine years, becoming also engineer of track elevation. Some 25 years ago he became associated with a firm of railroad contractors, and he was also one of the experts for the Chicago Smoke Abatement and Electrification Commission. Later he was engaged on the Chalmette terminal work at New Orleans. In 1915 he retired from practice and devoted himself to his personal business affairs. He became a member of the Western Society of Engineers in 1892, and of the American Society of Civil Engineers in 1889.

RODERICK CAMPBELL, 83, park engineer for the city of Syracuse, N. Y., for some years and one of the foremost park and cemetery architects in the United States, died at Utica, N. Y., May 30. He was born at Inverness, Scotland.

WILLIAM WALTER MACLAY died June 8 at Pittsfield, Mass., in his 84th year. He graduated from Annapolis Naval Academy shortly before the Civil War, served during the war in the U. S. Navy, and retired with the rank of Captain. Later he was connected with the New York City Dock Department, from which he retired in 1920. He was also president of the Glens Falls, N. Y., Portland Cement Company.

Construction Equipment and Materials

Colored Wood Preservatives Now Produced in Germany

Colored carbolineum applicable to wood preserving and to a certain extent in waterproofing also is being produced by Euettgers Werke A. G., Berlin-Charlottenburg, Germany, according to a report received by the U. S. Department of Commerce. The product is being marketed in various shades of red, blue, orange, yellow and other mixtures. Nitro-phenol compounds are also being employed in wood preservation by this firm.

Lumbermen Charged With Unfair Trade Practice

Complaints have been issued by the Federal Trade Commission against 38 companies charged with selling Western yellow pine as white pine. It is stated that retail dealers have stocked yellow pine to the exclusion of white pine, and have, intentionally or unintentionally, deceived architects, builders and wood manufacturers. The complaint points out that where the yellow pine has been used by builders misled into buying it as white pine, replacement is often necessary much earlier.

Among the respondents are the Long-Bell Lumber Company, Weed, Calif., and the Diamond Match Company, Chico, Calif. Most of the others are located on the West Coast.

Road Builders' Association Holds Group Meetings

On June 4, 6 and 7 the American Road Builders' Association held meetings in Cleveland, Chicago and Milwaukee respectively, for groups of the Highway Industries Association (Manufacturers' division of the American Road Builders' Association). At each meeting a complete and comprehensive outline of the past and present activities of the association was presented by Charles M. Upham, secretary-director. This outline included a description of the present organization, the seven divisions by which it functions and the method of obtaining educational information through committees made up of nationally known engineers and highway officials. Much stress was placed on the necessity of continued and increasing activity along the lines of good roads publicity and information in order that the public may be rightly informed as to the real value of highways and to combat evils and violations of correct practice which might cause a diminution of highway activity.

Other factors were mentioned constructively, including the necessity for widening programs, the possibilities of highway bonding and the improvement of highway management in counties and cities. The statement was made that the association was giving close and scientific study to all these subjects through its engineering force and committees and is well equipped to benefit materially the entire highway industry. The presentation of activities was brought to a close by an account of budget expenditures for the current year, including the division of funds for the various association activities.

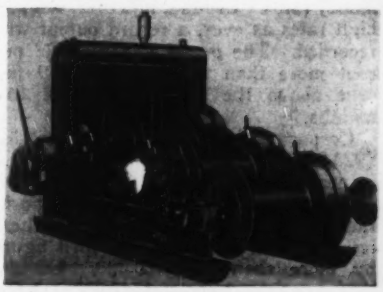
Following Mr. Upham's presentation of information, a general discussion of all subjects and policies was invited. The conclusions secured through these discussions, which represent in some instances the opinions of individual manufacturers and in others the result of a vote, are as follows: (1) A unanimous opinion that the educational and scientific work of the association shall continue; (2) A unanimous opinion that the funds expended by the association along educational and scientific lines are not excessive; (3) The greater percentage of manufacturers are in favor of an annual exposition held in different parts of the country; (4) The greater percentage of manufacturers are not in favor of regional shows.

New Developments

New Alloy Steel Used in 3½-Ton Hoist

A new hoist, designated as the model WH, has just been designed by the Novo Engine Company, Lansing, Mich., for handling loads up to 3½ tons. The standard line speed is 250 ft. per minute, and for higher speeds a special one-drum hoist is included in the series that has a line speed of 480 and 520 ft. per minute. This line of hoists is manufactured in 1-, 2- and 3-drum units.

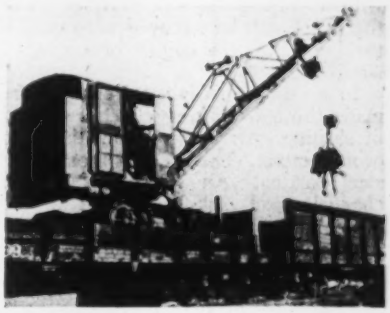
Exceptional strength and rigidity are claimed to have been assured by constructing the frame, gears, ratchets and pawls of Novite, a new alloy perfected by the Novo Engine Company. Novite



is said to have a transverse strength from 80 to 100 per cent more than cast iron, and a life of four to six times that of the best grade of semi-steel. An all-welded steel base is used and, to insure further rigidity, tubular spreaders rather than square castings or channels are used.

Special Crane for Railway Work Train Use

The most recent development of the Harnischfeger Sales Corporation, Milwaukee, Wisconsin, for use in the railway field is a supply-train crane now in use on the Chicago, Milwaukee, St. Paul & Pacific Railroad for salvaging and delivering material such as rails, ties,



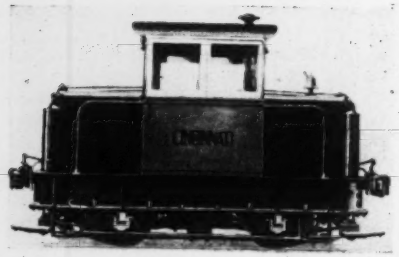
poles, etc. As shown in the accompanying illustration, the crane is mounted on a crawler unit placed on a flat car. It may thus be removed from the train with a minimum of trouble and applied to work in the yards.

The crane is equipped with an electric generator and magnet for picking up scrap, and a bucket and crane hook is also available. The crane has a short tail swing enabling it to work in any position without interfering with the adpacent track. Also, it can be unloaded from the side of the flat car, making it unnecessary to split the train when the crane is run off.

Gas Locomotive Designed for Performance

Believing that the weight of a locomotive is a secondary consideration in the average track haulage job, and that performance is much more important, the locomotive division of the Cincinnati Car Corporation has recently announced a new 1200 series gasoline powered, gear driven, industrial locomotive based upon this idea. Four starting and traveling speeds, both forward and backward, are provided. It is said that a large ratio of engine horsepower per ton of locomotive is also provided so that a liberal draw-bar-pull is available at all the different speeds.

Among the features of the engine are an oil purifier, gasoline strainer, temperature gauge (the latter being mounted on an instrument panel in the cab with the gasoline gauge), oil gauge, ammeter, and the different switches for control of ignition lights and starting equipment. A spray pump primer is



also available for use in starting in cold weather.

It is claimed that the clutch connecting the engine and transmission represents a marked improvement in clutches for locomotive service. Since it is inclosed in oil it can be slipped severely without any appreciable heating. Also the clutch can be removed without disturbing either the engine or transmission in any way.

In the transmission speed changes are made through shifting clutches instead of shifting gears, thus eliminating loss of momentum. The frame is a one-piece steel casting. An electrically welded channel steel sub-frame carries the power plant, transmission and all operating parts as a unit assembly which is rubber insulated from the main frame. The drive wheels are located inside of the frame so that the axle bearings are on the ends of the axle instead of behind the wheels.

New Publications

Electric Shovels — MARION STEAM SHOVEL COMPANY, Marion, Ohio, has issued a 15-p. booklet 281 which discusses in a non-technical way and from a historical standpoint present-day practice in the design of electric shovels. Particular attention is devoted to the question of alternating-current as compared with direct-current installations. The book is illustrated by many photographs of steam shovels, both early and modern, and contains a number of charts.

Light-Weight Concrete — AEROCRETE CORPORATION OF AMERICA, 51 East 42nd St., New York City, has issued a 56-p. illustrated booklet, "An Introduction to Aerocrete Economics and Engineering," which gives, in full detail, the story of Aerocrete, its properties and utilization, and treats of the economies made possible by the reduction of dead weight in building construction. One section is devoted to photographs of modern buildings in which Aerocrete is used.

Precast Concrete Sections — TEE STONE CORPORATION, 56 West 45th St., New York City, in a 12-p. illustrated booklet gives the advantages and applications of Tee Stone units in residence construction and other engineering structures. Tee stone units are precast, reinforced structural concrete building elements capable of a wide variety of uses and termed by the manufacturers "practical concrete lumber."

Business Notes

HUBER MANUFACTURING COMPANY, Marion, Ohio, has elected as its president and general manager A. W. Newby, formerly vice-president. He succeeds S. E. Barlow, who becomes chairman of the board.

BRODERICK & BASCOM ROPE COMPANY, St. Louis, Mo., has appointed Wells Fargo & Company Express, S. A., distributor for its wire ropes in Mexico.

TEXAS CREOSOTING COMPANY, Orange, Tex., has purchased the plant of the Houston Wood Preserving Company, of Houston.

MOHAWK ASPHALT HEATER COMPANY, Schenectady, N. Y., recently sold ten "Hotstuf" tool and asphalt heaters and ten "Hotstuf" torches to the Sicilian Asphalt Paving Company of New York City.

CONSTRUCTION MACHINERY COMPANY, Waterloo, Iowa, has appointed new agents as follows: George V. Treen, Charleston, W. Va.; Bournival & Company, Montreal, Canada; Construction Equipment Company, Salt Lake City, Utah.

YEOMANS BROTHERS COMPANY, Chicago, Ill., has appointed the Capitol Equipment Company, Charleston, W. Va., its representative in the southwestern part of that state.

JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, has appointed John L. Connors assistant general manager. Mr. Connors for the past nine years has been president of the Morgan-Gardner Electric Company, of Chicago.

TRACK SPECIALTIES COMPANY, New York City, has appointed as representative for the central territory the Hopkins Company of Chicago, Ill.

WAGNER ELECTRIC CORPORATION, St. Louis, Mo., has completed a new building in Buffalo, N. Y. which will house not only a branch sales office, but also a repair shop and service station for the entire Wagner line.

Construction, Labor and Material

New Capital Issues Set Record in May

April financing was comparatively low, the decline being attributed to high money rates. In May, however, with as high rates as ever, a record output was recorded. The grand total was 82 per cent more than for April and 39 per cent above the average for the five months.

Corporate bond issues in May totaled $923,000,000 (exclusive of refunding), compared with $594,000,000 in 1928. Industrial and miscellaneous corporations continued to float the bulk of these issues, which exceeded the April figure by more than $400,000,000. Of the public utilities total of $343,000,000, the $219,000,000 American Telephone and Telegraph Company 4½ debentures accounts for the bulk.

Another record to be noted in May financing is the large figure for refunding bonds. This amounts to $392,000,000, compared with a previous high of $361,000,000 in March, 1928. April refunding amounted to only $134,000,000, yet this was 18 per cent of the total, whereas in March the refunding per cent was about six. The May figure is 26 per cent.

The comparison of net issues in the first five months of this year and last is not a matter of showing increases and decreases from a year ago, but of stating the amount of the increase which is large in every instance. These increases for the principal groups were as follows: railroads, 66; public utilities 38; iron, steel, coal, copper, 71; industrial and manufacturing, 70; land and buildings, 5½; miscellaneous, 109.

Public Financing in May a Little Better

Long term borrowing by states and municipalities during May totaled $177,507,000 as compared with $141,285,000 in May, 1928, according to the *Daily Bond Buyer*.

Municipal bond issues sold during the first five months of the year totaled $535,759,227—the smallest figure since 1923, when new issues were only $445,046,939.

State and municipal issues reported approved during May aggregated $61,852,000. These cover the improvement programs of 201 communities, which in May, 1928, amounted to $136,689,000, and $79,033,000 in 1927. Of the 201 individual authorizations, 94 were for school district improvements and extensions.

Issues defeated amounted to $11,557,000, as compared with $17,841,000 in May, 1928, and $5,585,000 in 1927.

E. N.-R. Index Numbers

Cost		Volume	
June 1, 1929	**205.65**	**May, 1929**	**395**
May 1, 1929	205.15	April, 1929	332
June 1, 1928	206.15	May, 1928	299
Average, 1928	206.78	Average, 1928	287
Average, 1927	206.24	Average, 1927	263
1913	100.00	1913	100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of June 20, with some comparisons, total as follows:

(In Thousands of Dollars)

	June 20, 1929	June 13, 1929	June 21, 1928
Building:			
Industrial	$8,541	$8,604	$4,679
Commercial	53,181	41,274	29,935
Streets and roads	15,133	13,608	10,287
Other eng. constr.	9,506	13,578	12,234
Total	$86,361	$77,064	$57,225
Total, all classes, Jan. 1 to June 20			
1929			$2,178,130
1928			1,654,182